# The REFINER AND NATURAL GASOLINE MANUFACTURER

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**Steam Jet**
**EJECTORS**

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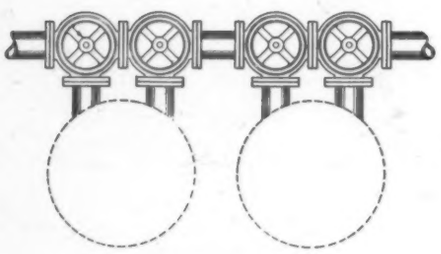
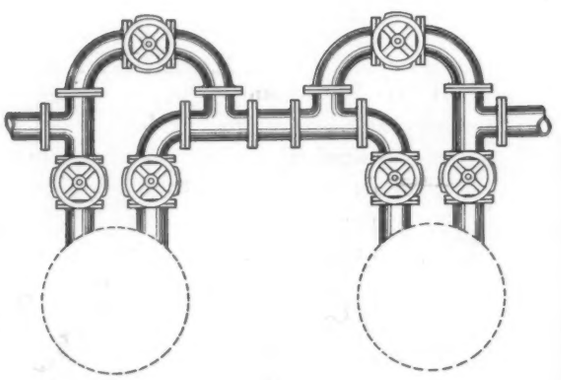


**2 UNITS USING BRAUN BY-PASS VALVES**



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# The REFINER

## AND NATURAL GASOLINE MANUFACTURER

*Edited Monthly at Tulsa, Oklahoma*

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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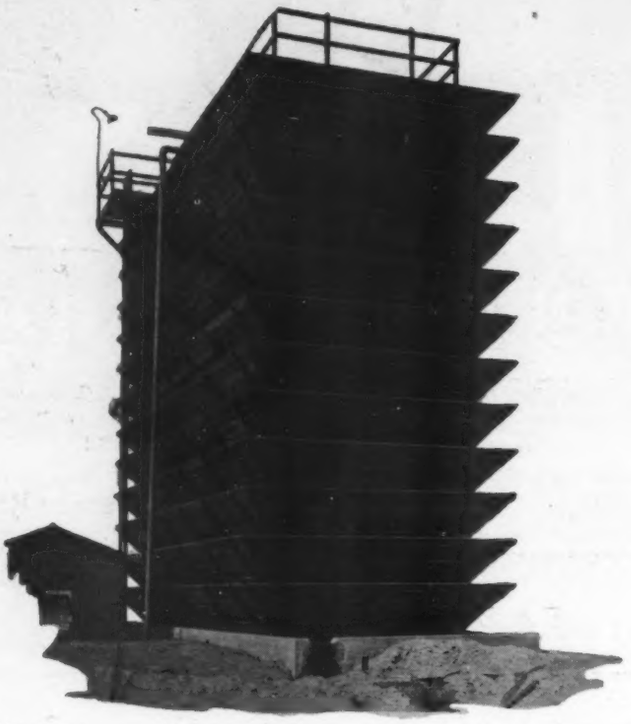

# FLUOR Advances

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**FLUOR REDWOOD COOLING TOWERS**

# *Beating the Season*

EACH year gasoline moves further away from a seasonal commodity. The line from January through December still has its high in July and August. But the peak no longer stands so much like a steep mountain. There is every assurance that this peak will continue to drop, as the low places rise.

Several conditions have contributed to this change and they will continue to alter the seasonal condition in gasoline consumption.

Foremost in bringing this change are the closed automobile and paved roads. These make it possible to use the family automobile in cold weather. Four passenger automobiles out of five now leave the factories with closed bodies. This ratio will not change much in future years.

But even the open cars are now so built that special enclosures make them fit for winter driving.

Road building, however, seems to have but started. Each year sees a growing total of hard surfaced roads completed. Each mile of it means increased winter driving.

Even in the regions where snows are suffiicient to halt traffic on paved roads, snow plows are coming into use to keep highways clear in all weather. This equipment is also motor driven and contributes its share to building winter consumption of gasoline.

The passenger bus is another agency that is increasing winter consumption of gasoline. Bus routes are fixed for regular schedules, winter and summer. The nature of the business demands that these schedules be maintained. Each routed passenger bus consumes in excess of 5,000 gallons of gasoline each year. It should consume just as much in January as it does in July.

Motor truck freight routes are, like the passenger bus, a steady user of gasoline. The nature of the venture demands regular schedules.

All these conditions make it incumbent upon the refinery executive to cease considering the consumption of gasoline from a seasonal standpoint. The change of today is of greater importance than most men believe. It will continue to change with each year and the change will be in favor of the refiner.

The time will never come when the curve of gasoline consumption presents a straight line across the calendar. But the time will come when the warm months will be designated by a gradual incline and decline. The mountain of summer will lose some of its height, while the valley of winter will lose some of its depth.

That changing condition is something for each refiner to study. What it means today and what it promises for tomorrow are subjects whose consideration may guide the way to better operation of refineries. As the mountain of summer loses its height, so the peak of refinery operation can be reduced to meet the changed economic condition.

In line with this the refiner should study the map of the United States from the standpoint of climate. The sections favored by warmer winters are the leaders in gasoline consumption. It is there that winter sales of gasoline are best. Selling efforts should shift with the seasons.

The distribution of gasoline from a refinery should be a scientific effort. It should yield to each economic influence. Climate and disaster, such as flood, are influences which should be respected. There is no virtue in striving to force a commodity into a community that can not absorb it.

Too little attention is given to all these influences, and gasoline will be better sold when they are heeded.

Grady Gilbert

# THREE New Cooper Type-19's Near Sarepta, Louisiana

*Ventura Fuel Company's Gas Compressing Plant Near Ventura, California, Contains Ten Cooper Type-19 Twin-Tandem, 760 B.H.P. Gas Engines Direct Driving Cooper Two-Stage Compressors.*

**Magnolia Gas Company is completing a compressor station near Sarepta, Louisiana, with three of the new Cooper Type-19 twin-tandem gas engines, each rated at 760 brake horse power.**

**This Cooper Type-19 engine has been developed especially for medium size gas compressing stations, large gasoline plants and gas-electric power installations. The design is the same as the Cooper larger gas engines and it therefore has the same reliability and economy. The parts are light enough to be easily hauled and erected, yet the unit is large enough to show a low construction and operating cost when compared on the horsepower basis.**

**It is built as a single cylinder 200 horsepower; twin cylinder 400 horse power; single-tandem 380 horse power and twin-tandem 760 horse power.**

## THE C. & G. COOPER COMPANY

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# Lion Plant Extracts Special Products From Smackover Crude

## Charging stock dehydrated. Operating methods held to pre-determined anti-knock gasoline specifications

By GEORGE REID
*Associate Editor*

THE Lion Oil Refining Company's El Dorado, Arkansas, plant designed and constructed in 1922 for refining of South Arkansas crudes, produces a variety of products not common to Mid-Continent refinery operations. The plant, which is 12,000 barrels capacity, is the largest in the State. As it is located in the heart of the producing fields of Arkansas, its charging stock is derived, in the greater part, from the Smackover field. From this crude the company refines a number of products ranging from road oils of varying asphaltic content, roofing materials, special naphthas, engine and stove distillates; as well as the usual gasolines recovered through skimming and cracking plant operations. These and other special products for which the company has built up market outlets call for flexible operating conditions at the refinery.

The plant consists of a skimming plant of nine 1000-barrel shell stills in continuous series for handling crude, 15 units of the Burton cracking process, one battery of six shell stills in continuous series of 5000-barrel capacity equipped for the distillation of crude or re-run stocks, and three 1000-barrel shell still and conjunctive bubble type fractionating equipment through which pressure distillate from the cracking plant is redistilled. With its auxiliary equipment such as chemical treating system, gasoline recovery plant, adequate tankage and loading facilities, the plant is strictly modern in its design and construction.

Smackover crude produced and refined by the Lion organization does not differ from the usual run of Smackover oil; practically all of which is contaminated to greater or lesser extent by water, and salts in solution. Sulphur derivitives add to the refining troubles. Since the water and salts give trouble in the distillation and fractionation processes it is necessary to remove them prior to charging the crude to stills. Much of the Smackover crude is dehydrated in the fields, which practice is attended by loss of the lighter vapors and high dehydration costs.

### Dehydrating System

Lion Oil Refining Company dehydrates its crude oil at the refinery in a plant designed especially for this purpose by Sylvester Dayson, general superintendent of the refinery, who has been in charge of the development of this refinery since its inception in 1922. The dehydrating plant consists of a series of four tubular retorts or heating units. The "wet" crude is first passed through two of the heaters and raised in temperature to around 200 F. and returned to storage tanks for settling. From this settling storage, where a large proportion of water, salts and sediment settle free of the oil, the crude is taken to the remaining two retorts and in its pass through the tubes its temperature is increased to 300 F.

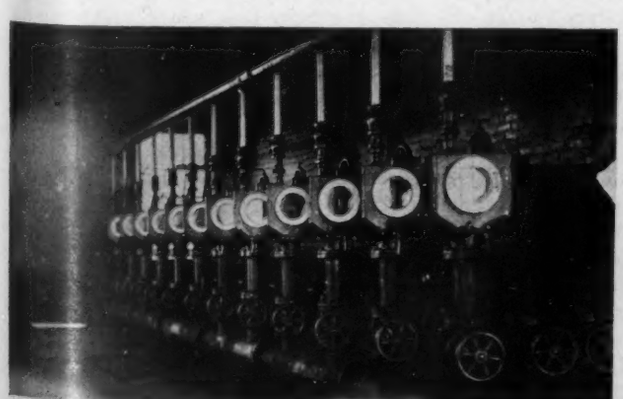
Leaving the last tubular retorts the crude is conducted to the top of a large flash chamber where especially designed equipment causes it to drop in a spray to meet an upward rising stream of steam which has been subjected to superheat. This steam, which is exhaust from plant operations, is superheated in tubes which are placed laterally in all of the furnaces, thus utilizing the heat of these furnaces for raising its temperature. As the rising steam meets the descending oil in the flash chamber, all of the remaining moisture in the oil is stripped from it and conveyed with the steam and a portion of the oil which is also vaporized, to condenser box and storage.

In the storage tanks the water and light oil quickly separate and the oil is pumped to the refinery for utilization there. Crude oil which accumulates in the bottom of the flash chamber is almost free of water and foreign matter. The customary or usual results of this dehydration involves a reduction of water and b.s. content from 20 per cent. to .4 of 1 per cent.

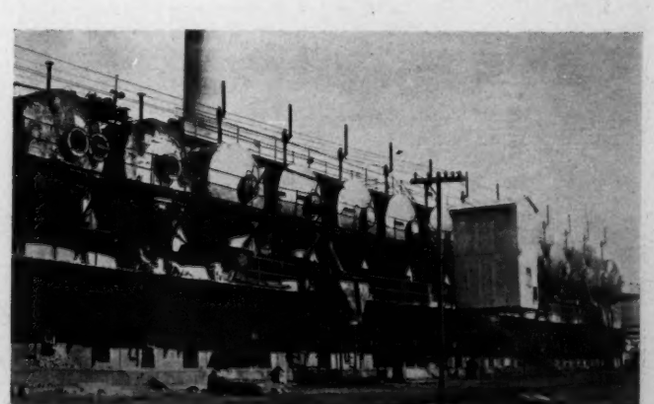
This dehydration is conducted at a cost not exceeding $.016 per barrel and also effects the saving of the light distillate formerly lost in field dehydration. The Lion dehydrator removes practically all of the water, salts and foreign matter, and the practice is in a large measure responsible for the efficiency secured in the skimming operations. In addition the removal of the extraneous matter in the crude before it enters the shell stills has been of much assistance in the matter of combating and reduction of corrosion to refining equipment.

### Shell Still Operation

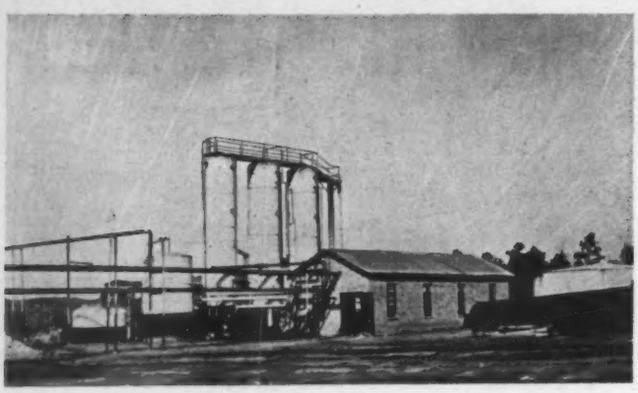
The dehydrated crude oil is then transferred to tankage and ready for charging to the continuous battery of nine 1000-bar-



*Interior of No. 1 receiving house. Note sampling devices extending from side wall of the look boxes.*



*Fifteen units of Burton cracking stills, used to crack gas oil derived from Smackover crude.*



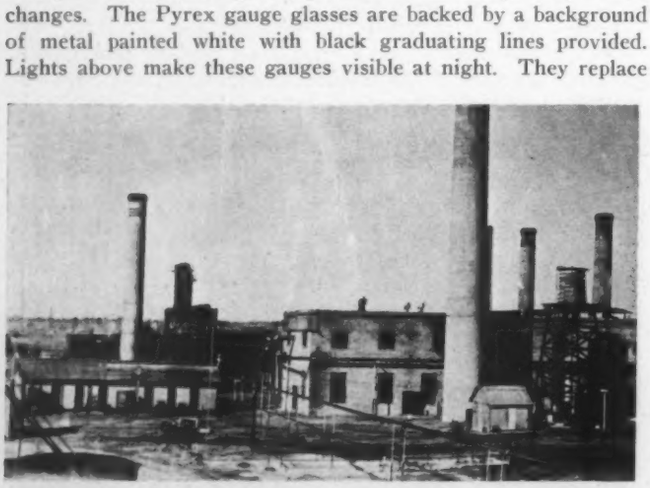
*Gasoline recovery plant extracting gasoline from vapors derived from 15 units Burton cracking plant, two refinery receiving houses and light oil tanks*

rel shell stills. The liquid level in the shell stills is hed at about 40 per cent. of the still capacity. The 60 per cent. space thus provided for vapors is a distinct aid in securing the desired separation of light and heavy ends. The exact manner of operating this battery is governed to a large extent by the type of products required by the sales department, which is in close co-operation with the refining department, and this in turn may largely depend upon market conditions. The lighter ends from the skimming plant may be redistilled and special naphthas secured. This provides the base stock used in the refinement of some of the other company products. All of the nine fractions taken overhead from the skimming battery may be blended together and used as charging stock for the cracking units—or any number of these streams are used as cracking plant charge stock. Heavy Smackover crude yields very little distillate of naphtha specifications. The greater portion of the overhead distillate is gas oil.

The crude when charged is 18-20 gravity A. P. I. and in the skimming process it is reduced to a residuum of 6 to 8 A. P. I. gravity. The series of stills is so manifolded at the back that any still in the battery may be by-passed by the opening and closing of block valves provided for this purpose. Since the residuum is very heavy in the transfer lines it has been found helpful to inject some steam into the transfer sections to assist in moving the heavy oil from one still to another.

### Gauge Control

All of the shell stills on the plant are equipped with liquid level gauges which are of Pyrex glass, especially selected for its ability to withstand high temperatures and abrupt temperature changes. The Pyrex gauge glasses are backed by a background of metal painted white with black graduating lines provided. Lights above make these gauges visible at night. They replace



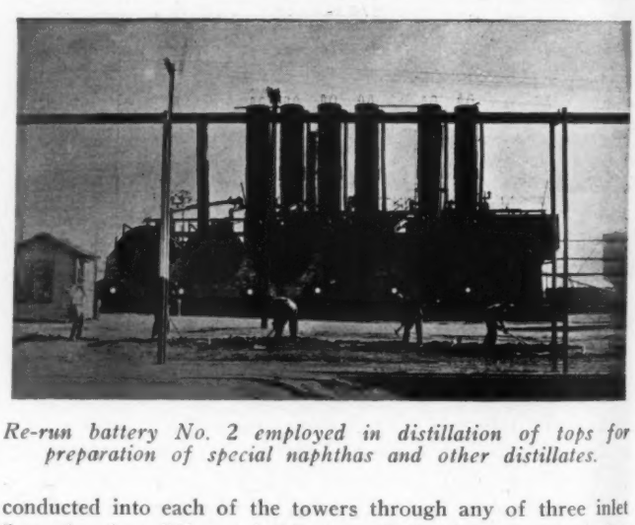
*Skimming stills and re-run battery equipped with Winkler and Koch bubble type towers. All buildings at Lion plant are of brick and concrete construction.*

the series of pet cocks usually found at the back of stills with which the men in charge determine the liquid level. The glass gauges have the important advantage of continuous visibility.

These gauge glasses are provided with automatic check valves which are installed in the lines from the still shell to the glasses. In the event of glass breakage the valve immediately closes and prevents loss of oil and possible fire. Additional advantage lies in the fact that no oil is wasted behind the stills, nor is the ground and setting at the rear of the battery a perpetual fire trap due to spilled oil. Naturally the most important advantage is the saving of time to the operators. With the aid of the glass, the stillman can note instantly the liquid level of all the stills in the battery, and since the level is always visible, it is easier to maintain. The gauge glass with automatic check valves is perhaps less hazardous than the pet cock for determining liquid levels, since danger of fire exists when liquid or vapor is blown out of the stills. Occasionally the liquid blown out is above its flash point and ignites upon contact with the air. Stillmen have been seriously burned and serious refinery fires have occurred through the careless handling of "pets" at the rear of stills.

### Skimming Method

Another time saving device at one battery of stills is found in the system of manifolds in the receiving house by means of which the operator has control of the volume and point of entry of the recycle media which is pumped back over the bubble towers. The cool distillate used for refluxing can be



*Re-run battery No. 2 employed in distillation of tops for preparation of special naphthas and other distillates.*

conducted into each of the towers through any of three inlet lines placed at different levels through the simple manipulation of valves in the receiving house whenever the character of the streams indicate that a change is necessary. Thermostatic controls on the towers likewise aid in controlling the battery.

The usual method in skimming the Smackover crude at the Lion plant consists of utilizing the first two stills in the crude battery to take off 35 to 38 gravity tops, which may be re-run for gasoline and kerosene. The remaining seven stills produced the charging stock for the 15 Burton cracking units. The composite stream from these stills averages about 28-30 gravity. The stream from the first of the seven stills being around 32 gravity, and from the last still, about 20 gravity. Special hot oil pumps withdraw the residuum from the last still, which, as previously mentioned, has a gravity of around 80 degrees A. P. I. Much of this residuum is marketed as road oil. Some is blended back with residuum from the cracking stills which results in the production of a finished, carbon free, free flowing, exceptionally low cold test fuel oil of high B.t.u. content.

At present most of the re-running of pressure distillate derived from the cracking operations is carried out through three of the 12 shell stills. These three shell stills were recently equipped with Winkler and Koch design bubble type fractionating columns. The charging stock is preheated first

## ENGINEER'S LOG SHEET

| DATE | BOILER HOUSE | | | BATTERY No. 1 | | | PRESSURE STILLS | | | BATTERY No. 2 | | | DEHYDRATOR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL GAS BURNED M CU. FT. | CU. FT. GAS PER H. P. DEVELOPED | FUEL COST PER H. P. DEVELOPED | THROUGH-PUT BBLS OIL | CU. FT. GAS PER BBL. OIL | COST PER BBL. OIL FOR Fuel & Steam | THROUGH-PUT BBLS OIL | CU. FT. GAS PER BBL OIL | COST PER BBL. OIL FOR Fuel & Steam | THROUGH-PUT BBLS OIL | CU. FT. GAS PER BBL OIL | COST PER BBL. OIL FOR Fuel & Steam | THROUGH PUT BBLS OIL | CU. FT. GAS PER BBL OIL | COST PER BBL. OIL FOR Fuel & Steam |
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Average Cu. Ft. Gas Per H. P. Boiler House
Average Cu. Ft. Gas Per Barrel of Oil, Battery No. 1
Average Cu. Ft. Gas Per Barrel of Oil, Battery No. 2
Average Cu. Ft. Gas Per Barrel of Oil, Pressure Stills
Average Cu. Ft. Gas Per Barrel of Oil, Dehydrator

Average fuel cost per horse power Boiler House
Average Fuel and Steam Cost Per Barrel Oil throughput Battery No. 1
Average Fuel and Steam Cost Per Barrel Oil throughput Pressure Stills
Average Fuel and Steam Cost Per Barrel Oil throughput Battery No. 2
Average Fuel and Steam Cost Per Barrel Oil throughput Dehydrator

*Engineers Log Sheet used by Lion Oil Refining Company for daily determination of costs, other than labor, involved in processing oils at all batteries in the plant. This important information is on the manager's desk by 11 o'clock each day.*

by passing through a control section at the top of the three large towers, then passing through a heat exchanger of conventional type before entering the first still. Transfer from the first to second still is effected by means of a steam jet which conducts the partially denuded oil into the second tower through one of three lines serving as points of entry. This oil then flows downward through the tower over the trays and into the still through the reflux line. The same system is employed to transfer from the second to the third still in the series. Through this type of hook-up the three stills are now doing the work of a former battery of six stills and doing it more efficiently from the standpoint of fractionation, as well as increased capacity or throughput involving less equipment.

### Gasoline Yields

Pumps for handling the charging stock to the re-run battery, charging both over the cooling sections at the tops of the towers and into the heat exchangers, are located beneath the condenser boxes and very close to the battery. The flow of pressure distillate is maintained at whatever rate desired and the residuum pump maintains a constant or uniform level in the last still. The bubble towers fractionate very closely, removing all of the available gasoline from the stock charged to the battery. The overhead streams from the battery are run together and the blend is a gasoline meeting U. S. motor specifications with anti-knock value 45 per cent. benzol equivalent. The bottoms from this unit are of such specifications that they meet requirements for red engine distillate. At many refineries such bottoms are only suitable for blending with fuel oils.

Under this method of operation the recovery of U. S. motor gasoline based on the crude run to stills is 32 per cent. This yield is secured when 70 per cent. gas oil is secured in the skimming operation, 65 per cent. pressure distillate in the cracking operation, and 70 per cent. U. S. motor fuel from the re-run stills. Gasoline yields, when all costs are considered, and the value of the remaining products, compares very favorably with the best results secured in the refining of heavy Smackover crude.

Another interesting time and labor saving device at the Lion plant is found in the method used for taking samples of streams in the receiving houses. One of the company's stillmen has perfected a sample "grabbing" cup which remains permanently inside of the look box and swings into and away from the stream as desired. The advantages are that the look boxes may be permanently sealed and gas tight, which permits the gasoline recovery plant to withdraw vapors and gases which contain no air. Again the device permits more rapid sampling of the streams and obviates the necessity of removing the cap from the top of the look box. The tightly closed boxes eliminates the escaping vapors usually found in receiving houses and greatly reduces the fire hazard. No vapor is permitted to escape which might be ignited by sparks, which is one of the most frequent causes of refinery fires.

The sampling device consists of all small fittings. A small piece of one-inch pipe is used inside of the conventional type Reid look box, and this pipe swings back out of the stream when not in use, toward the front of the look box. At the lower front of the Reid look box a hole is provided in the side wall, which is usually plugged and not used. The Lion sample line merely takes advantage of this hole, using a one-inch tube inside of the box, which reduced to the size of the side wall hole, and by an "el" and nipple, passes out of the box and into a packed gland inserted in the side wall of the look box so that the smaller pipe is free to turn inside of the packed gland. A globe valve at the end of the half-inch pipe controls the outlet from the sample cup inside of the look box. From the globe valve and "el" and nipple discharges into the sampling cans.

When a sample is to be taken of any stream the device is merely turned so that the one-inch pipe, serving as a "sampler" inside of the look box, is swung into the stream of oil passing through the box. Sufficient liquid is run out of the stream to fill the sampling can. When enough oil is secured the sampling cup is swung out of the stream again. The device is simple in construction and requires only a one-foot length of one-inch pipe and about the same length of half-inch pipe, two "els," a half-inch valve, and common "cap" which serves as the

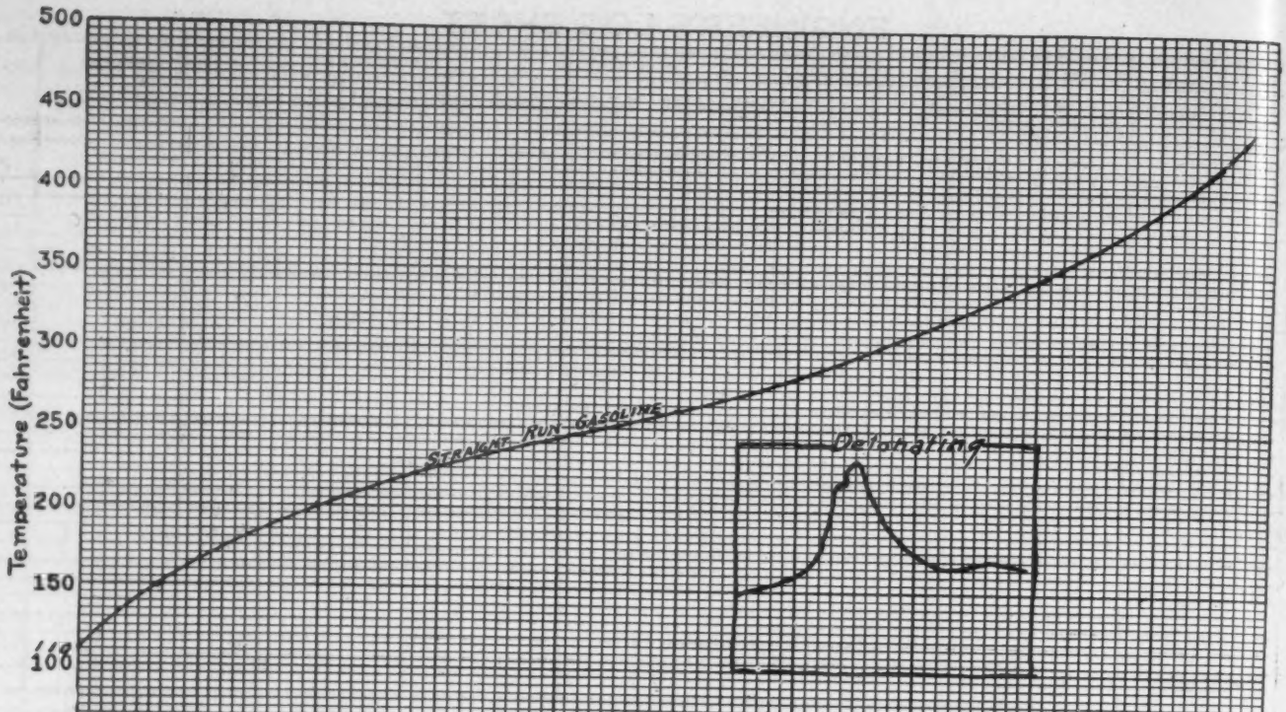


*Chart No. 1*

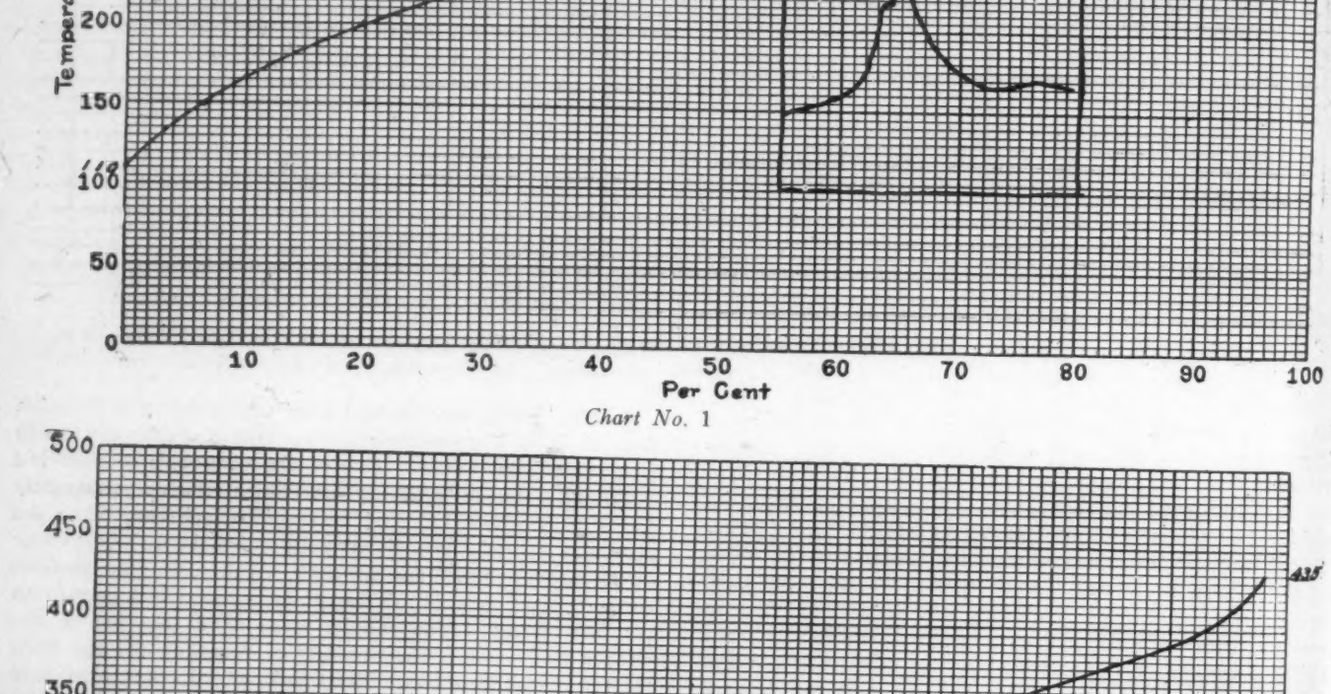


*Chart No. 2*

*Charts 1 and 2 are indicative of the difference between cracked gasoline from Smackover crude and ordinary straight run gasoline, both from the standpoint of physical characteristics as indicated by the straight run curve, and in anti-knock value as shown by the smaller "no knock" curves. No. 1 is chart of paraffin base gasoline. No. 2 is that of cracked gasoline from Smackover oil, in this instance marketed under the trade name, "Lionzol".*

stuffing box or packing gland by simply boring a hole in its top. The principal advantage in the use of this type of sampling connections lies in the elimination of air from the gases going to the tail gas recovery plant, for the look boxes can be tightly closed with gaskets. Much spilling is eliminated through their use and the receiving house is therefore more easily kept clean.

Smackover crude oil, during late years, has become very well known throughout the petroleum industry, as the source of gasoline of high anti-knock value. The presence of aromatic and naphthenic hydrocarbons in the crude, which is commonly called asphalt base, makes the gasoline from this crude somewhat similar in physical and chemical characteristics to the gasolines of California. Unfortunately there is not much natural gasoline in the crude, but it makes an excellent charging stock for cracking, with the result that the gasolines produced by the pressure processes are of greater value from an anti-knock standpoint than the straight-run portion. The Lion company markets its cracked gasoline as a premium grade of motor fuel, under the trade name of "Lionzol." After months of exhaustive research and experiments involving the blending of one or several petroleum hydrocarbons in varying proportions, each fraction having distinct characteristics as to its properties of unsaturates, aromatic, etc., Mr. Dayson and his staff determined just what proportions were necessary for the preparation of the motor fuel of highest anti-knock value obtainable from the crude at hand, with the result that the plant is operated for the purpose of securing the greatest quantity of a quality product. The accompanying charts indicate something of the difference in physical characteristics between the anti-knock gasoline produced at this plant from Smackover crude, and a gasoline derived from paraffin base crude. The anti-knock or anti-detonating value of 40 to 50 per cent. superiority over a paraffin base gasoline was determined by the method known as "General Motors bouncing pin motor."

### Engineer's Log Sheet

The method of determining costs of boiler plant and distillation equipment operation varies with different organizations. The subject is one of much interest to refiners everywhere. Many plants have certain systems of accounting whereby they determine these various costs on a monthly basis, or over even longer periods. Mr. Dayson has compiled a chart whereby these costs are determined on a daily basis, and the information placed on his desk each morning. The form shown indicates the cost per barrel of refining oils in each battery each day. Fluctuations in such costs are quickly noticeable and corrective measures undertaken at once. Note that the form shows at the extreme left the amount of fuel consumed by the boiler house in the generation of steam for the plant. Since the plant is burning gas for fuel the form shows the million cubic feet consumed by the central power plant, then the cubic feet consumed per horsepower developed and the cost per horsepower developed. This cost naturally assumes a more or less even keel over a period of time and fluctuates either with extreme weather conditions or with greater volumes of crude distilled or dehydrated in the plant. Any abrupt variation is certain to be noticed and its cause quickly determined.

Since steam is metered to the dehydrators and to the various distillation battery, such as skimming plant, re-run battery and pressure stills, these units are charged with the amount used. In addition the gas consumed for firing is metered to each battery and this, too, is charged against the operations.

### Fluctuation Shown Daily

After a short time the average costs for each operation in each department is determined and the fluctuations above or below the standard or lowest cost contingent with best efficiency are shown daily. With this type of record the men in charge of each department are aided in the operation and control of their respective still batteries and so forth. Also these operators are forced to give strict attention to fuel and steam consumption in the various departments, or they are called upon to explain any increase in operating costs which might occur, due to steam leaks, too generous use of steam, and careless handling of fuel.

# Pure Oil Company Is Host to N. P. A.

Marcus Hook, Pa.—The newer, sounder spirit of co-operation in the manufacturing branch of the oil industry was exemplified recently when the Pure Oil Company opened its big refinery here to inspection by members of the National Petroleum Association. It was an occasion which would have been impossible only a few years ago.

In spite of the fact that competition is keener today than it ever was in the history of the industry, oil men have learned that they have more in common than their differences. They have learned to work together; they have learned that they can share many of their successful ventures without jeopardizing the essential success of their individual enterprises. More than that, they have come to feel that what they share with other companies engaged in the same industry means a gain and not a loss.

Mr. Dawes asked Vice-President Webber to come from Chicago for the occasion and he brought with him R. C. Osterstrom, one of the councillors of the Department of Standards and Tests. E. A. McCadden, in charge of the refinery, with John Grace and Charles Clark were the other hosts.

The guests were divided into four groups and during the day were shown the laboratory, tube stills, Cross cracking stills, receiving house, contact filters, continuous treaters, agitators, wax plant, power plant, acid sludge pots and concentrators, cooperage shop, barrel house, machine shop, loading racks and docks. There was plenty of opportunity for discussion of points of interest as they developed.

The guests were taken to an interesting inn, which was built in Colonial days, where they were guests of the Pure Oil Company at lunch. There President Lyons and others expressed the thanks of the association to the company for its hospitality.

This refinery visit was held as a part of the activities of the association's Department of Manufacture.

The representatives of member companies who attended were:

Carl Alsberg, Franklin Creek Refining Company; A. F. Anderson, Crew Levick Company; C. A. Boler, Tiona Refining Company; E. F. Burch, Crew Levick Company; Edward Bush, Acewood Petroleum Corporation; C. P. Caulkins, Tri-State Refining Company; Charles Clark, Pure Oil Company; Lon Crawford, Kendall Refining Company; G. C. Davison, Tri-State Refining Company; Fayette B. Dow, general counsel, National Petroleum Association; A. A. Forter, Crew Levick Company; A. P. Frame, Crew Levick Company; Luther Fulton, Pennzoil Company; M. J. Glynn, Emlenton Refining Company; John Grace, Pure Oil Company; J. W. Griswold, Crew Levick Company; D J. Harvey, Pennzoil Company; L. C. Jamieson, Viking Oil Corporation; E. M. Keeley, Crew Levick Company; O P. Keeney, The Keeney Oil Company; E. M. Lyons, Tiona Refining Company; W. W. Lowe, Henry L. Doherty & Company; A. Mulhaupt, Jr., Kendall Refining Company; E. A. McCadden, Pure Oil Company; Bruce Northrop, Ohio Valley Refining Company; R. C. Osterstrom, Pure Oil Company; Earl Petty, McKean County Refining Company; W. R. Reck, Bradford Oil Refining Company; H. E. Shoemaker, Independent Refining Company; S. P. Stannard, Pennsylvania Oil Products Refining Company; H. W. Walchli, Tiona Refining Company; N. H. Webber, Pure Oil Company; M. B. Whitney, M. B. Whitney Company; R. A. Wotowitch, Henry L. Doherty & Company.

# Two Million Tank Cars Is 1928 Gasoline Demand

## Automobiles head the list, with airplanes last; motor busses are largest individual users of motor fuel

By H. J. STRUTH
*Petroleum Economist*

TWO million tank cars—fifteen billion, eight hundred and fifteen thousand gallons — represents the total 1928 gasoline demand to be supplied by refineries. Of this huge quantity of gasoline more than three-fourths, or 12,365,000,000 gallons, will be consumed by motor vehicles.

An analysis of the gasoline requirements for 1928 reveals some interesting data that should prove helpful to the refiner in determining his markets, as well as the quantity and quality of gasoline utilized for various purposes. The following table presents, for the first time, a detailed analysis of the annual gasoline demand for various types of motor vehicles, as well as the approximate quantities required for air transportation, miscellaneous domestic uses and exports:

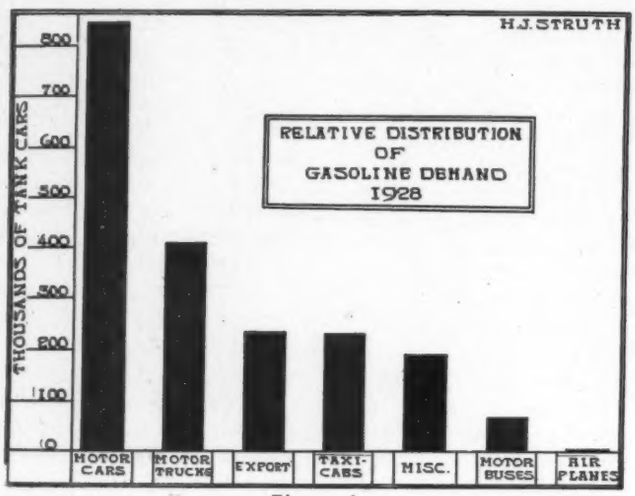


*Figure* 1

**Detailed Analysis of Gasoline Requirements**
**Year 1928**

| | Monthly Average Motor Vehicles (1928) | Average Annual Consumption per Vehicle (Gals.) | Total Consumption Millions of Gallons | Total Consumption Thousands of Tank Cars | Per Cent. of Total |
|---|---|---|---|---|---|
| Motor cars | 20,150,000 | 334 | 6,737 | 842 | 42.6 |
| Motor trucks | 3,200,000 | 1,014 | 3,244 | 406 | 20.5 |
| Taxi cabs | 1,200,000 | 1,541 | 1,850 | 231 | 11.7 |
| Buses | 92,500 | 5,775 | 534 | 67 | 3.4 |
| Total motor vehicle requirements | 24,642,500 | 501 | 12,365 | 1,546 | 78.2 |
| Airplanes | ..... | ..... | 4 | 0.5 | ..... |
| Misc. uses | ..... | ..... | 1,546 | 193 | 9.8 |
| Exports | ..... | ..... | 1,900 | 238 | 12.0 |
| Grand total | ..... | ..... | 15,815 | 1,977.5 | 100.0 |

In an accompanying chart, figure 1, these facts are strikingly compared. Motor cars, the chief consumer of gasoline, use more than twice as much motor fuel as motor trucks, nearly four times as much as taxi cabs, and fourteen times the quantity consumed by motor buses. In this connection it is well to point out that the rapid expansion in American motor bus routes is a most important factor in future motor fuel markets, because every bus added to this vast new system of transportation creates a demand for an additional 5,775 gallons (average) of gasoline annually. Thus, it is readily apparent that the future of the gasoline business is only limited by the ability of the refining industry to supply its demands. The idea that there is a saturation point in the motor vehicle field has long ago been dispelled. This year we take it for granted that next year will show a consistent gain in motor vehicle registration, with a consequent increase in the demand for gasoline. If we are able to estimate with reasonable accuracy the number of motor vehicles in operation from year to year, and have some idea of the annual gasoline requirements of various types of motor vehicles, it is not difficult to determine what our aggregate gasoline requirements will be.

### Airplane Lowest

It is interesting to note that the quantity of gasoline required for the operation of airplanes will aggregate a bare four million gallons—only a "drop in the bucket," compared with other channels of distribution. It has been ascertained from information obtained from the Department of Commerce, Washington, that commercial air lines will probably fly about sixteen million miles this year. This indicates that commercial planes will require about 2,500,000 gallons of gasoline this year. In addition, it is estimated that the army and navy will also require about 1,500,000 gallons for the operation of service planes. From information obtained from commercial aviators it has been ascertained that the average plane consumes about 12 gallons of gasoline per hour of flying time, or an average of about eight and one-half miles per gallon. While many refiners are of the opinion that aviation offers a huge future market for gasoline, the fact should be borne in mind that the future of aviation may bring the universal adoption of the Diesel engine. Thus, while we may experience a growing demand for aviation gasoline for the next few years, the future may witness some radical changes in engine design that will entirely eliminate gasoline as an aviation motor fuel, to be replaced by fuel oil.

### Taxes Misleading

While the Bureau of Public Roads releases information concerning the collection of gasoline taxes by States, it has been learned that quite a number of the States exact a tax on gasoline used for propelling motor vehicles only,

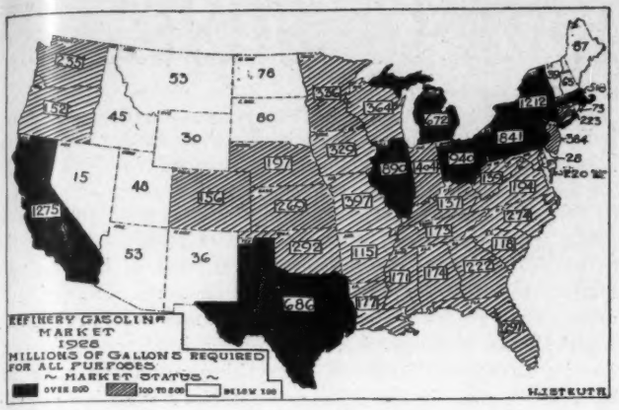


*Figure 2*

while others tax all gasoline consumed. This indicates that the gasoline consumption figures released by that bureau are not a true picture of the quantity of gasoline consumed by motor vehicles. Quite frequently we see reports purporting to show the average annual consumption of gasoline per motor vehicle in the various States. In many cases these estimates of annual average consumption include large quantities of gasoline consumed within the States listed for purposes other than the propelling of motor vehicles. The chart shows that nearly 10 per cent. of the gasoline sold today is used for other purposes than the operation of motor vehicles. Some of the uses to which this quantity of gasoline is put are: Industrial internal combustion engines, tractors (road and farm), motor boats and launches, motorcycles, cleaning and dyeing, and for use as a solvent. These uses include not only gasoline, but also benzine and naphtha, which the refiner generally includes in his Bureau of Mines report under the gasoline classification.

Figure 2 shows the geographical distribution of the 1928 gasoline demand. Eight States, California, New York, Ohio, Pennsylvania, Illinois, Texas, Michigan and Massachusetts, will consume in excess of a half billion gallons of gasoline this year. California and New York are the largest gasoline consumers, with a demand in excess of a billion gallons each. While this map includes gasoline consumed for all purposes in each State, it also serves as an indicator of the principal motor fuel markets.

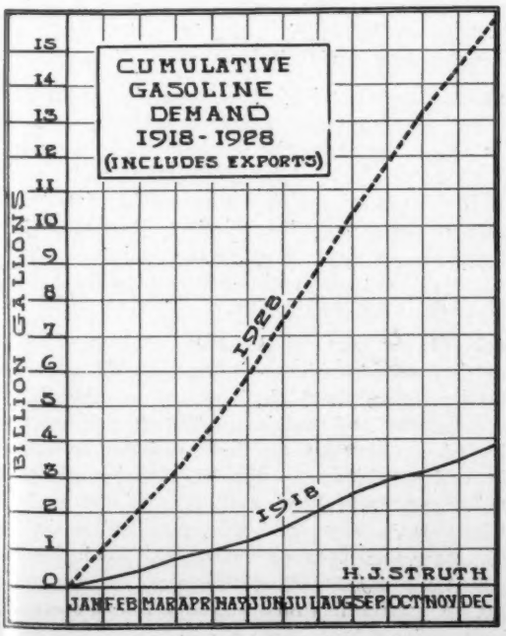


*Figure 3*

## Climate Controls

Climate is perhaps the most important factor in determining the annual gasoline requirements of the various States. Almost without exception, the Southern States, with their long motoring season, are the largest consumers of gasoline per motor vehicle. A striking example of this is a comparison of the gasoline requirements in Pennsylvania and of Texas. Although Pennsylvania has considerably more motor vehicles than Texas, 1,686,000 against 1,176,000, Texas uses almost as much gasoline annually for operating its motor vehicles as does Pennsylvania. This year Texas will consume 646 million gallons of gasoline, while Pennsylvania will consume 674 million gallons in the operation of their respective motor vehicles. Although the average consumption per motor vehicle, in the United States, has been estimated by the writer to be 501 gallons for the year 1928, the facts show that the average varies in different States from a low of 347 gallons in Vermont, to a high of 706 gallons in Florida.

Some idea of the climatical effect in various States upon the annual gasoline demand can be obtained from the accompanying table. This table is the basis upon which the map was prepared and shows for each State the monthly average number of motor vehicles for 1928, the average consumption per motor vehicle, total motor vehicle requirements, gasoline required for all other purposes, and the total requirements for each State:

**State Gasoline Requirements for 1928**

| State— | Monthly Average Motor vehicles (Thousands) | Average Consumption Per vehicle (Gals.) | (Millions of gallons) Total Motor Vehicle Demand | Other Consumption | Total Dom. Cons. |
|---|---|---|---|---|---|
| Alabama | 256 | 597 | 153 | 21 | 174 |
| Arizona | 83 | 578 | 48 | 5 | 53 |
| Arkansas | 209 | 493 | 103 | 12 | 115 |
| California | 1,781 | 665 | 1,189 | 86 | 1,275 |
| Colorado | 282 | 508 | 143 | 13 | 156 |
| Connecticut | 315 | 539 | 170 | 53 | 223 |
| Delaware | 51 | 529 | 27 | 1 | 28 |
| Florida | 407 | 706 | 287 | 10 | 297 |
| Georgia | 318 | 595 | 189 | 33 | 222 |
| Idaho | 106 | 380 | 40 | 5 | 45 |
| Illinois | 1,514 | 529 | 800 | 90 | 890 |
| Indiana | 846 | 380 | 322 | 82 | 404 |
| Iowa | 716 | 430 | 308 | 21 | 329 |
| Kansas | 513 | 588 | 250 | 19 | 269 |
| Kentucky | 289 | 412 | 119 | 18 | 137 |
| Louisiana | 269 | 583 | 157 | 20 | 177 |
| Maine | 167 | 425 | 71 | 16 | 87 |
| Maryland & D. C. | 438 | 441 | 193 | 27 | 220 |
| Massachusetts | 981 | 464 | 456 | 62 | 518 |
| Michigan | 1,163 | 535 | 622 | 50 | 672 |
| Minnesota | 672 | 450 | 302 | 34 | 336 |
| Mississippi | 258 | 612 | 158 | 13 | 171 |
| Missouri | 712 | 502 | 357 | 40 | 397 |
| Montana | 115 | 450 | 47 | 6 | 53 |
| Nebraska | 376 | 497 | 187 | 10 | 197 |
| Nevada | 30 | 434 | 13 | 2 | 15 |
| New Hampshire | 103 | 514 | 53 | 10 | 63 |
| New Jersey | 761 | 407 | 310 | 74 | 384 |
| New Mexico | 65 | 537 | 35 | 1 | 36 |
| New York | 2,082 | 516 | 1,075 | 137 | 1,212 |
| North Carolina | 452 | 555 | 250 | 24 | 274 |
| North Dakota | 166 | 392 | 65 | 13 | 78 |
| Ohio | 1,675 | 507 | 850 | 90 | 940 |
| Oklahoma | 525 | 515 | 271 | 21 | 292 |
| Oregon | 257 | 498 | 128 | 24 | 152 |
| Pennsylvania | 1,686 | 400 | 674 | 167 | 841 |
| Rhode Island | 128 | 485 | 62 | 11 | 73 |
| South Carolina | 213 | 480 | 102 | 16 | 118 |
| South Dakota | 175 | 388 | 68 | 12 | 80 |
| Tennessee | 300 | 513 | 154 | 19 | 173 |
| Texas | 1,176 | 551 | 646 | 40 | 686 |
| Utah | 99 | 383 | 38 | 10 | 48 |
| Vermont | 75 | 347 | 26 | 13 | 39 |
| Virginia | 347 | 467 | 162 | 32 | 194 |
| Washington | 427 | 450 | 192 | 43 | 235 |
| West Virginia | 265 | 450 | 119 | 20 | 139 |
| Wisconsin | 742 | 463 | 346 | 18 | 364 |
| Wyoming | 57 | 495 | 28 | 2 | 30 |
| Total | 24,643 | 501 | 12,365 | 1,546 | 13,911 |
| Airplanes | .... | .... | .... | .... | 4 |
| Exports | .... | .... | .... | .... | 1,900 |
| Grand Total | .... | .... | .... | .... | 15,815 |

This study has also revealed that there is an average of

only 53 gallons difference between the quantity of gasoline consumed by the average motorst during the warm and cold months of the year. As a mateer of fact, we are approaching the time when every month in the year will be a "peak" gasoline month. The advent of the closed car has made marked changes in monthly gasoline consumption, as is shown by the following table of monthly gasoline consumption per motor vehicle:

**Monthly Gasoline Consumption Per Motor Vehicle**

| | Gals. | | Gals. |
|---|---|---|---|
| January | 31 | July | 49 |
| February | 30 | August | 49 |
| March | 38 | September | 47 |
| April | 40 | October | 43 |
| May | 45 | November | 41 |
| June | 47 | December | 41 |

Every month during 1928 will be a billion gallon month for the gasoline industry, while the last eight months of this year will have witnessed a demand for more than a billion gallons each, for motor vehicles alone. The following table gives some carefully prepared data concerning the monthly gasoline demand for motor vehicles, miscellaneous uses and exports. It also shows the cumulative gasoline demand throughout the year, which is plotted graphically in figure 3, in comparison with the cumulative gasoline demand in 1918.

**Monthly Gasoline Demand**

(Millions of Gallons)

| Month— | Motor Vehicles | Mis. Uses | Exports | Total | Cumulative |
|---|---|---|---|---|---|
| January | 765 | 101 | 152 | 1,018 | 1,018 |
| February | 754 | 96 | 150 | 1,000 | 2,018 |
| March | 936 | 113 | 139 | 1,188 | 3,206 |
| April | 980 | 126 | 156 | 1,262 | 4,468 |
| May | 1,120 | 144 | 194 | 1,458 | 5,926 |
| June | 1,160 | 149 | 182 | 1,491 | 7,417 |
| July | 1,200 | 146 | 139 | 1,485 | 8,902 |
| August | 1,200 | 153 | 178 | 1,531 | 10,433 |
| September | 1,159 | 141 | 151 | 1,451 | 11,884 |
| October | 1,058 | 132 | 169 | 1,359 | 13,243 |
| November | 1,020 | 126 | 158 | 1,304 | 14,547 |
| December | 1,013 | 123 | 132 | 1,268 | 15,815 |
| Total | 12,365 | 1,546 | 1,900 | 15,815 | .... |

The refiner who has been interested in the movement to expand the market for gasoline will be interested to know that the average motorist will use more gasoline during 1928 than ever before. Figure 4 illustrates this point clearly. Compared with the year 1918, motor vehicle registrations have increased 326 per cent., while the demand for gasoline has increased 345 per cent. This shows conclusively that the average motorist is using more gasoline. The chart shows that the demand for gasoline had relatively overtaken the rate of growth in auto licenses last year, passing its record by eight per cent. at the close of the year. This year, it is anticipated that this tendency will show further acceleration, exceeding the rate of auto license growth by 19 per cent.

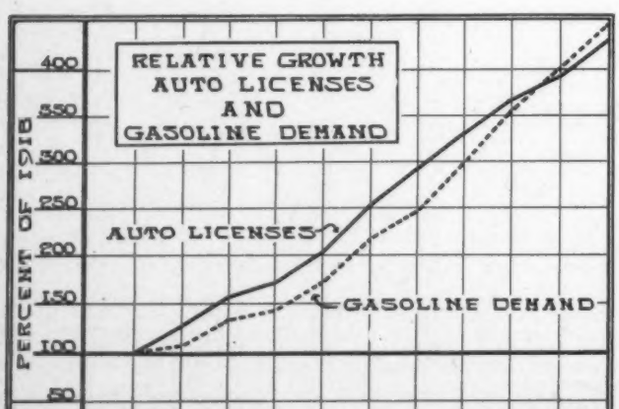


*Figure* 4

By the end of this year, the writer estimates that there will be 25,705,000 motor vehicles in the country, presaging another record-breaking gasoline demand in 1929. Since the average consumption per motor vehicle seems to be definitely growing larger, it is a foregone conclusion that the future gasoline market will present not a problem of how to obtain more gallonage, but, rather, one of how to adequately satisfy the demands of the consumer. Resorting to advertising to increase gasoline gallonage is probably a worthy idea, and one that will aid the industry in correcting its situation. However, everything points to a natural natural increase in the average motorist's gasoline requirements; the constantly growing mileage of improved highways, comfort and easy riding qualities of present-day motor cars, ability to travel long distances in the all-weather closed car, and the growing popularity of the motor bus for both short and long trips. All of these factors are bound to promote a constantly greater demand for gasoline, for it is more true today than ever before—that we are a nation on wheels.

# Export Movement of Oils Through Gulf Ports

Washington.—In line with averages maintained during the preceding seven years, 48 per cent. of the gasoline and 46 per cent. of the kerosene exported from the United States in 1927 passed through three ports of the Gulf Coast: New Orleans, Galveston (Houston and Texas City), Sabine (Port Arthur and Beaumont), according to a statement analysis made by Arthur H. Redfield, assistant economic analysist of the United States Bureau of Mines, Department of Commerce.

"These ports, however," the statement declared, "handled only 20.3 per cent. of the national exports of fuel oil and gas oil in 1927, as compared with 36 per cent. in 1924, and 51 per cent. in 1921.

"Less gasoline and kerosene were exported in 1927 from these ports to the United Kingdom, France and Italy than in 1926, and more to the smaller countries of Europe. Sales of fuel oil and gas oil to Europe, to Central America and to the West Indies increased. Canada, Cuba, Spain and Germany bought more crude oil from the Gulf Coast.

"Western Europe received more than nine-tenths of the 20,458,477 barrels of gasoline exported in bulk from the three ports in 1927. Four-sevenths of these shipments went to the United Kingdom, France, the Netherlands and Sweden. Of the 806,099 barrels of gasoline exported in containers, 42 per cent. went to South America, chiefly to Argentina, Brazil and Uruguay; 29 per cent. to Australia and New Zealand; 12 per cent. to Africa; nearly nine per cent. to the Far East, and the rest to the Caribbean region.

"Nearly 81 per cent. of the 7,796,553 barrels of kerosene exported in bulk from the Gulf Coast in 1927 was shipped to Europe, chiefly to the United Kingdom, the Netherlands, France, Germany and Belgium. Fifteen per cent. went to British India, and most of the remainder to Algeria and Tunisia, and to China. Of the 1,139,260 barrels of kerosene exported in containers 43 per cent. was shipped to Asia, chiefly to China, Hong Kong, and Kwantung and to the Philippine Islands. More than 24 per cent. went to South America, principally to Argentina, Brazil and Uruguay. Africa received 15.6 per cent., Australia and New Zealand 10.7 per cent., and the Caribbean region 6.1 per cent.

# Unique Methods Produce French Transformer Oils

## American refiners now supply part of stocks and do some processing prior to shipment

By GEORGE W. CUPIT, Jr.

OF all the methods for making transformer oils, the French method appears to be the most unique. As we have our specialties in refining petroleum products in this country, they, too, have them, and in this instance it is transformer oils. The French have always required the most stringent specifications of these oils. This is not only true for oils that they themselves make, but it is likewise true for oils which are made in other countries for France.

Before going into the manufacture of transformer oils according to the French method, let us investigate some of the requirements they insist upon these oils meeting. Since both physical and chemical changes enter, it may be well to outline the specifications at the beginning of the article.

*Chemical and Physical Specifications*

1. Acidity in terms of $SO_3$—not over .02 per cent.
2. The oil must possess a neutral reaction.
3. The oil must not contain sulphur, asphalt or resin.
4. The oil must be void of alkalis.
5. The oil must be absolutely void of moisture.
6. The oil must not contain any foreign impurities.
7. Sludge Test: French method—
   5 hours—Nil
   50 hours—Nil
   135 hours—0.08—0.1 per cent.
8. Tendency to oxidize—Must be at a minimum.

*Physical Tests*

1. Color—N.P.A.:Not darker than 1¼
2. Flash—(Luchaire):—170-175 C.
3. Flash—(P.M.):—355°F.
4. Gravity—(Specific) @ 60°F.:— .855—.870
5. Pour Test (Paraffine Base):—30° Max.
6. Pour Test (Asphaltic):——3°C.
7. Volatility (French Method):—.085%.
8. Volatility (German Method):—.2—.3%
9. Dielectic Strength:—35,000 Volts
10. Viscosity—Engler @ 20°C.:— 6.0—6.2
    Engler @ 35°C.:— 2.8—3.0
    Engler @ 50°C.:— 2.0—2.1

The Dielectric Resistance Test must average 35,000 volts tested three times, the test having been made on three different samples of the oils being tested. The test must be made between two spheres 10 mm. in diameter and 5 mm. apart. The sample of oil prior to testing should be dried at 110 degrees C. for six hours and then cooled in a closed chamber, for example, a dissicator. The sample as dried should be held in a room having 70 per cent. humidity for 48 hours and should not lose more than 50 per cent. of its dielectric resistance. The oil after standing for 70 hours at 120 degrees C. in the presence of oxygen must remain clear and must dissolve completely in benzine Sp. Gr.—.700. The tar content must not be over .10 per cent.

A test of particular importance is that regarding the tendency to alter the insulating materials. It may be carried out in the following manner. Two hundred grams of cotton thread are heated with the oil in an open copper vessel for 300 hours. After this time the cotton shall not have lost less than 60 per cent. of its original strength. The results may be determined by comparing its strength before and after test is made. Refined oils of this nature possess certain other characteristics of which I deem necessary at this writing to speak. Transformer oils in the presence of air have a tendency to oxidize and form sludge slowly at temperatures around 175 degrees F. This is particularly noticeable in the presence ot catalysts.

The greater amount of unsaturated constituents in the oil, the shorter the life of the oil becomes on account of the tendency to form deposits. On this account, therefore, the method of refining should be such that all unsaturated compounds present in the transformer stock will have been removed when the last stages of refining have been completed. Not only does heat effect the color of the oil but it likewise causes the formation of unsaturated compounds and incidentally acids. It is quite obvious, then, why the greatest skill should be exercised in refining these oils in order that they meet the stringent French requirements.

### Selection of Crude

Since a great many of the French transformer oils are used in cold climates they have wisely selected low cold test crudes produced in the Russian oil fields. Certain grades of transformer oils are made from the Galician oils, due to the fact that the finished products give practically no deposit when subjected to the French 135-hour sludging test. The Germans are aware of this characteristic, too, and their purchase of these crudes for the purpose of manufacturing transformer oils has created no little competition. In addition to the above mentioned crudes from which the French obtain transformer stocks, there has come into use (exported from the United States) a distillate made from Gulf Coast crudes. This distillate represents the stock for transformer oils refined according to the French method. More information regarding this will be given later.

Aside from the Texas Gulf Coast crude, there is another source from which an excellent transformer stock has been obtained. It is one of the Mid-Continent crudes possessing a paraffine base with a gravity of 43.0 Baume. On distillation it yields 43.0 per cent. over at 410 degrees F., and 68 per cent. over at 608 degrees F. The transformer stock made from this crude differs from others in that it is neutral in character. Further information will also be given regarding the preparation of this stock under the heading "Production of Transformer Stocks."

### Production of Transformer Stocks

The fire and steam distillation of the four crude oils mentioned above, with one exception, is the same. However, the object in all cases is to produce an overhead cut which when re-run will give a stock having a viscosity of 90 to 105 Saybolt with good acid treating properties. It should be kept in mind that in the case of the Texas Gulf Coast crude the distillate obtained will possess naphthenic qualities, whereas, that made from the Mid-Continent possesses paraffine qualities.

In refineries where only a limited amount of oil can be handled, it is the general procedure to distill the oil in batch stills rather than run it continuous. In either case, it is important to remember that at no time during distillation should the temperature exceed 600 degrees F. and the maximum amount of steam should be induced into the still during the entire reduction.

The still operation as carried out by the French is identical

with ours and consists of charging and firing the still in the usual standard way making a cut between 60 and 170 viscosity at 100 degrees F. Saybolt, representing the transformer stock cut. This is re-run for an overhead cut representing a viscosity range of 90 to 105. This procedure is carried out on the naphthenic base crudes which yield low cold test distillates. The production of the transformer stock made from the paraffine base crude is quite different from that obtained from the naphthenic base crude. The main reason for this is due to the fact that a neutral stock is desired.

### Production of the Neutral Transformer Stock

The first step in the production is that of topping the crude oil until the bottoms have a gravity of 31.0 to 31.5 or a viscosity of 145 degrees 100 degrees F. Saybolt. This will give an average yield of bottoms of 50 per cent. on all crudes ranging from 41.0 degrees to 42.5 degrees Baume. However, a yield of 55 to 57 per cent. of bottoms has been obtained from crudes having a gravity of 36.0° Baume. In this case, the viscosity was found to run slightly heavier 150 to 170 at 100 degrees F. Saybolt. After the oil has been reduced to within this viscosity range it is ready for acid treating.

### Acid Treatment of Reduced Oil

After leaving the still the oil is circulated through a series of cooling coils to bring the temperature down to 95-100 degrees F. The best results have been obtained by acid treating the oil at this temperature. After all valves have been checked on the treating agitator and the charging line set the oil is pumped into the agitator to the correct outage. In practical plant operation the amount of acid used is one pound of 66 degree Baume $H_2SO_4$ per gallon of oil treated. The acid treating may be done in either one or two dumps. This will have to be determined by the treater according to the nature of the crude being processed. Some crude oils have sufficient self-finishing qualities that it is necessary, in those cases, to either blow or pump the acid onto the oil, without air agitation. Also in these cases a water finish (to break out the acid sludge) is unnecessary. Be that as it may, in the case where the acid is used in two dumps, it is advantageous to use water for breaking the sludge in the latter dump.

Generally, when two dumps are necessary to obtain the best treating results, for instance color, the greater amount of acid is used on the former dump followed by the remainder of the acid sufficient to bring the total amount of acid used to one pound per gallon treated. Some refineries maintain that better results are obtained by giving the oil the smaller amount of acid on the first dump, while others argue to the contrary. To this I might add that it depends wholly on the nature of the crude. In the majority of cases the French use the greater amount of acid on the first dump. The acid is added without agitation and when all acid is pumped on the oil, both are agitated by air.

No set time for blowing can be previously determined for no two crudes treat exactly alike. This matter is left to the treater. A good treater realizes the importance of getting the acid on the oil as quickly as possible and the acid sludge away from his oil as quickly as is possible. Hence the finishing of the oil is the most important step in acid treating. After the oil has been finished the sludge is allowed to settle from one to two hours, at the end of which time it is drawn off into a sludge cooking kettle for further processing.

### Neutralization and Washing

From the treating agitator the sour oil is transferred to the wash agitator where it is neutralized with 16 degrees Baume caustic soda. Care should be taken in neutralizing the oil that a slight excess of alkali is present, else upon heating to washing temperature the oil will have a tendency to darken, especially if it is slightly on the acid side. After neutralization, the oil is heated to approximately 180 degrees F. without agitation. The soaps are then drawn off the bottom and the oil again tested for alkalinity. If the oil at this stage of refining has lost its alkalinity, it will be necessary to add more caustic soda until the oil, tested with phenolphthalein as an indicator, gives a positive result. It is of vital importance to remove the heavy soaps formed on neutralization, as their presence causes the oil to emulsify when washing. When the last traces of soaps have been drawn off, the oil should again be agitated with air and a representative sample of the agitator tested for alkalinity. If positive, the oil is ready for a water wash.

To the oil with agitation are added approximately 25 per cent by volume of hot water. The contents are allowed to agitate 45 minutes, care being taken that a temperature of 180 degrees F. is maintained throughout the washing. At the termination of this time the oil and water are allowed to separate by settling three to four hours. The water wash containing soaps is drawn to the sewer until oil begins to run at the draw-off. In cases where separation between water and oil is incomplete, it has been found necessary to give a second wash. When all water has been drawn off, the oil is brightened by air blowing. At this stage of refining the oil is ready for further still reduction.

### Fire and Steam Distillation for Neutral Stock

This procedure is carried out in a batch still according to the following fractionation:

Cut No. 1—Over to 39.0°Be. = Water White Distillate
Cut No. 2—39.0° — 34°Be. = 300 Stock
Cut No. 3—34.0° — 28.8°Be. = Neut. Trans. Distillate
Cut No. 4—28.8° — to off = Re-run Stock
Bottoms—150 Vis. @ 210°F. = 150 Vis. Cyl. Stock

All the steam the still will take during the fractionation of the first three cuts is added. The cut in which we are particularly interested in Number 3. In order to meet the pour specification, it is necessary to remove the wax by first chilling and then pressing. The chilling operation is done by means of Carbondale chilling machines, which reduce the temperature of the oil gradually and uniformly to approximately 3 to 6 degrees F. At this temperature the oil is pumped to a 32-leafed press where the crystalline wax builds up in the press plate by plate until the pressure builds up to a point where very little chilled distillate passes through the press. At this point, the oil is turned into another filter press and the first press is cut out. The pressed oil as it leaves the press drops into a run-down tank (sometimes a ground tank) from which it is pumped through an exchanger and then into a storage tank. In this manner use is made of the reduced temperature to aid in precooling the unpressable distillate prior to its entering the Carbondale chillers. It is unnecessary to go into any further details regarding chilling and pressing of the oil. The pressed distillate obtained from the above procedure will show a cloud test of approximately 20 degrees F.

### Re-run of Pressed Distillate

This reduction can be carried out either according to the gravity of the bottoms or the viscosity of the bottoms. In general practice it has been found better to reduce to the latter, since viscosity of the finished product is one of the controlling specifications. Since this is the case, it will be necessary, therefore, to reduce to 93 vis. at 100 degrees F. Saybolt, and although this is a little lower in viscosity than the finished product calls for, the difference is made up by the relatively heavy acid treatment which the oil received at a subsequent stage of refining. The other tests which the 93 viscosity bottoms will possess are gravity, 30.6 Be.; Flash, 350 degrees; Fire, 410 degrees F.; Cloud, 32 degrees. The yield of transformer stock from this distillation will be about 80.0 per cent. It is very important that the reduced oil be as low in temperature as

possible on account of the very heavy acid treatment which the oil will receive in the next step in processing.

Unlike most procedures followed in acid treating, the French have one of the most unique methods used.

The treating house is built in three stories with a raised roof (approximately four feet) above the treating agitator. The reason for this is to permit the gases formed while acid treating to pass off into the air. This is aided by means of revolving blowers (into-the-wind-type), situated above the treating agitator. The required amount of oil for one acid treat, usually 700 barrels, is pumped into the agitator located on the third floor. The transformer oil stock tank is likewise a ground tank. When charged the agitator is tested for moisture and if present to any degree should be drawn off by means of a draw-off valve located at the bottom of the agitator. The best treating temperature has been found to be 60 to 65 degrees F. In summer, however, due to weather conditions, it is difficult to maintain this low a temperature. Hence they cool the charging stock to not over 70 degrees F. before pumping any acid into the agitator.

When this has been accomplished, air agitation is begun by means of a compressor, also situated on the ground floor. In this manuscript I shall give the quantities of chemicals used in American terms. While the oil is agitating, the first dump of 66 degrees Be H2SD4 is pumped on the oil to the extent of six carboys per 100 barrels of oil treated. The time required for complete agitation is one hour. At the end of this time the contents of the agitator are allowed to settle five to six hours. The acid sludge is then drawn off at the bottom into a sludge cooking kettle located on the ground outside the treating house. When all sludge is off a subsequent dump of 66 degrees Be H2SO4 (93.5 per cent. acidity) is given the oil in like manner as above. After settling six hours longer the sludge is again drawn off. The sludge at this stage of acid treating will be dry and smooth. No difficulty should be encountered in removing the sludge.

The third dump of acid used is 98 per cent. H2SO4 to the extent of 26 carboys per 100 barrels of oil treated. All acid is tested for per cent. acidity before being used. The third dump of acid is pumped on the oil while oil is agitating, but the blowing time is increased to two hours. At the expiration of this time the oil and acid are allowed to settle 12 hours, at which time the sludge is drawn off. At this point a representative sample of the oil is neutralized, washed and brightened to determine its color. If the oil fails to meet 1½ N. P. A. color, it is given a fourth dump of acid, which in nearly every case brings it to color specification. After the last traces of sludge have been removed the oil is then ready for neutralization. In order to do this the oil is run by gravity into the wash agitator located on the second floor.

### Neutralization and Washing

While the oil is dropping into the agitator from above caustic soda is used in neutralizing the sour oil. The best results have been obtained by neutralizing with 15 degrees Be NaOH, which is done by means of air as the oil drops into the agitator. The agitation is reduced to a minimum by just barely rolling the oil and caustic. When the transfer is complete and the presence of a slight excess of alkali is evidenced, the contents of the agitator are allowed to settle overnight. Next morning heavy sulphonic soaps will have settled to the bottom of the agitator. These are drawn off and retained. Many times the oil will have lost its alkalinity and further addition of alkali is necessary.

In every case, whether the oil is slightly acid or slightly alkaline, it is given an alcoholic caustic wash to remove the last traces of soaps. When this is done, the oil is ready for a spray wash after it has been raised by means of jacketed steam to a temperature of 160 to 170 degrees F. A sample of oil at this point is tested for a slight alkalinity. Invariably it will show a slight excess. The alcoholic caustic wash is drawn off and retained for further use. The tendency for the oil to emulsify will be inversely proportional to the amount of soaps removed. However, no two oils react alike and if a tendency to emulsify occurs, the steam should be shut off and oil allowed to settle. In almost every case after steaming slightly it is possible to remove considerable soaps. When indications show that the oil will wash without emulsifying, steam is added for 45 minutes, at which time approximately 25 per cent. by volume of hot water is added and the contents steamed one hour longer, then settled eight to 10 hours. The milk water is drawn off to the sewer and the oil is brightened by means of blowing with air while hot. At this stage of refining the oil is ready for clay treatment.

### Clay Treatment of Oil

Just in recent years has the application of fine clay been applied to oils commercially for use in decolorization. The finest of clay obtained in grinding, which at one time was discarded on account of having no practical use, is now used with marked success. In preparing the clay for use the roasting temperature should not exceed 550 degrees F. at any time during burning, and in burning to this temperature the rate of rise should be gradual and uniform. Since the clay is used at a temperature of 300 degrees F., a considerable saving can be made both in time and cost of heating by applying it to the oil after it has cooled to this temperature.

The object of applying the clay to the oil at this temperature is two-fold, namely, to bring the oil to the optimum temperature and to remove as much undesirable organic matter as is possible. The claying agitator, therefore, should be perfectly clean before the brightened oil is drawn down into it from the second floor wash agitator. Certain French refiners at first believed that if the claying were carried out in an iron agitator that certain detrimental catalytic reactions would have a tendency to darken the oil at the above temperature rather than lighten it. In several cases this was found to be the case. However, the cause was proved conclusively not to be the iron agitator, but due to the fact that the temperature of the oil was considerably higher than that of the clay at its time of application. Needless to say, then, the temperature of the oil prior to clay treatment was kept below that of the clay, which was 300 degrees F.

After blowing the oil bright with air the oil was transferred by gravity to the clay agitator located on the first floor of the treating house, and allowed to cool to 140 degrees F. At this temperature and with the aid of 6 per cent. powdered clay, the oil and clay were agitated by means of a revolving paddle so constructed as to give the oil not only a horizontal stirring, but likewise a verticle swirling. After agitating one-half hour, the oil and clay were pumped through a thirty-two-leaf filter press, which removed all the clay and prepared the oil for enough subsequent clay treatments to bring it up to the color specifications. As a rule it required four treatments of clay, totaling 24 per cent. for Gulf Coast oils and 18 per cent. of clay, representing three 6 per cent. treatments of clay for the neutral oils.

On the second and third treats of the former the optimum temperature was 230 degrees F., and on the last treatment of clay the temperature used was 140 degrees F. From the press the oil was pumped to a storage tank and allowed to cool to atmospheric temperature. So far, there has been no method developed for reclaiming the spent clay on account of there being such a relatively small quantity of clay used in comparison with the amount of oil

treated. It was considered impractical and, therefore, the clay was discarded.

Of all the tests these oils are required to meet, the two most important are those of color and sludge formation. Although the color of an oil is by no means a criterion of the quality of that oil, it is a difficult matter, to say the least, to teach the public this fact. Since the sludge test, together with its stringent specifications, is so important, I deem it necessary at this time to outline its procedure. This is the most important test, and is considered the controlling specification. The method for testing is as follows: Duplicate samples of oil to be tested for each length of hour run are placed in test tubes of 15 mm. diameter by 150 mm. long. Ten grams of oil are used for determination. The test tubes containing samples of oil are inserted in an oil bath, care being taken that the oil levels in the tubes are below the oil level of the bath. This oil bath is then surrounded by another oil bath.

The double oil bath containing the test tubes is placed in an air oven electrically controlled and set at a temperature of 302 degrees F. The run is carried out for periods of five hours, 50 hours, and 125 hours. The regular 135-hour run was shortened to 125 hours due to the fact that the difference in time running caused practically no further sludge precipitation and also it standardized the time for beginning and finishing the test run. At the expiration of these times (five hours, 50 hours, 125 hours) the test tubes are removed from the oil bath and cooled.

Gooch crucibles, which have been prepared with asbestos, washed with carbon tetrachloride, are dried to constant weight and desiccated prior to use.

Each cooled test tube containing treated oil is emptied on a prepared Gooch crucible on which suction is applied and the test tube washed thoroughly with 60 to 62 degrees Be Naphtha. Likewise the crucible is washed with same. The Gooch crucible is then transferred to another suction flask and washed with carbon tetrachloride until the wash liquid is as clear running through the filter as it is going on to the same. This solution is then evaporated in a clean and previously weighed dried glass dish to dryness. The increase in weight represents the sludge formed. The percentage sludge is then calculated from the weight of the original sample taken.

So profitable are the oils made according to the above process that France practically controls the sales in the European countries. The transformer stocks obtained from European crude oils are inadequate to meet the demand. Therefore, they have called upon this country to supply them with what they need. Part of the processing is carried out in this country by our refiners, but that part of the processing which they consider most important is left to be carried out at the French refineries. A good transformer oil will contain not higher than .012 per cent sludge in the finished product.

A favorable comment which can be made regarding the French method is the unique setting of the apparatus to carry out the process. A great deal of time has been saved over the American method of processing. However, it should be remembered that we manufacture transformer oils on a much larger basis. The recovery of acid sludge I have omitted for the specific reason that it is handled like all sludges obtained by treating lubricating oils. The average time in processing a neutral stock is 115 hours, while that for processing a Gulf Coast stock is 200 hours. In the manufacturing of transformer oils it is inadvisable to speed up the process in order to rush the oil through. Notwithstanding the success that the French are having in manufacturing and selling transformer oils at a price better than their competitors, they are aware of the fact that they will have to keep right up with their research on this subject in order to hold her own with Germany. Germany is beginning to specialize along this line, too. However, France has an excellent start.

# Protection of Tanks

PROTECTION of tanks that hold sulphur laden oils has become a vital subject with the development of the "sour oil" fields of West Texas.

That some solution to this corrosion problem will come is certain. Here is a suggestion from a man, who terms himself, "an outsider." It is offered in the hope that it will result in the methods being tried:

"In view of the fact that considerable damage from oil of high sulphur content in tanks is taking place, may I be allowed to make some remarks which may be useful to the oil companies, both at the production fields and in the refineries.

"The damage to the tanks is partly to the tank roofs where hydrogen sulphide gas combines with the iron forming sulphide of iron; here it also sets up considerable heat during the formation of the sulphide of iron and it is quite probable that this fact has been the cause of the spontaneous combustion to which various tank explosions have been attributed.

"The other damage is to the bottom of the tank, where from salt water contents of the oil and also condensations in the tank form a combination between water and sulphur which has caused the formation of sulphurous acids and this in many cases has caused considerable pitting in tank bottoms.

"This latter, in my opinion, could be avoided entirely if oil tanks were built with wells in the bottom and if the bottoms of the tanks were slightly sloped towards the wells.

"Any sulphurous acid which would form in the tank would, of course, go to the bottom by law of gravitation and very quickly find its way into the well. From the well it could be siphoned out in a lead-lined pipe of suitable size. In this way the bottom of the tank would always be in contact with crude oil and not with any acid and would be as perfectly preserved against corrosion as the tank sides, the only part of the tank subject to damage being the well and the under side of the tank roof. At the outlet from this lead lined pipe a valve would be fitted, which could be opened from time to time, in order to empty out such acid as may have collected. This pipe would, moreover, be a convenience to the oil companies for the purpose of emptying out the heavy slush which generally collects at the bottoms of tanks. This could then be collected without labor in tank cars or otherwise and used for such purposes as might be indicated.

"I do not know whether this idea has ever suggested itself to tank builders or to oil companies. It would appear rather strange that it should first occur to an outsider like myself, but the fact of the increased damage due to the West Texas oils of high sulphur content has brought this matter prominently before the general public and the time has evidently arrived when even an outsider may be allowed to give such matters his consideration.

"I remain yours very truly,

"A. C. HOLZAPFEL,
President International Compositions Company."

# Possible Saving in Fuel by Utilizing Exhaust Steam*

By L. M. JOHNSON and J. L. FARRELL
*Producers & Refiners Corporation*

THE Parco refinery of the Producers & Refiners Corp., is situated in the southeastern part of Wyoming, and operates principally on the crude from Lost Soldier oil fields. This crude is asphalt-paraffin base, 32 degrees A. P. I. gravity, 50 degrees F. pour test. It requires heating in the pipe line system from the oil fields to the refinery, and heating in the refinery tank storage to keep it mobile.

The average atmospheric temperature for several months of the year is below zero; temperatures as low as 30 degrees below zero are experienced in the winter months. These conditions tell very emphatically upon the boiler house winter load.

The refinery has a rated capacity of 10,000 barrels crude per day, but is operating on 5000 barrels at this date.

### Plant Units

A brief description of the refinery units follows:

1. Crude Stills: No. 2 battery, five shell-type stills, 12-foot diameter by 40 feet long; bubble towers; crude-residuum heat exchange; gas fired; gas recovery system.

2. Pressure Distillate Re-run Stills: No. 2 battery, five shell-type stills, 12-foot diameter by 40 feet long; bubble towers; gas oil bottoms—pressure distillate heat exchange; vapor heat exchange; gas fired; gas recovery system.

No. 1 battery (shut down), five shell-type stills, 12-foot diameter by 32 feet long; bubble towers; gas fired; gas recovery system.

3. Lube and Slop Stills: No. 1 battery (shut down), five shell-type stills, 12-foot diameter by 32 feet long, gas fired.

4. Dubbs Stills: 4000 barrels capacity; six units; two units are 72-tube furnaces; four units are 62-tube furnaces; 10-foot diameter by 40 feet high, electric welded reaction chambers; six Dow hot-oil pumps; 3-foot 6-inch diameter by 21 feet 2 inches long dephlegmators; common steam turbine driven centrifugal raw oil and pressure distillate recirculating pumps; Lientz flue gas recirculating system, fans steam turbine driven; steam turbine driven centrifugal charging pump; steam duplex pumps.

5. Light Oil Batch Treating Plant: Two 1000-barrel agitators; steam-driven pumps and air compressor.

6. Light Oil Continuous Sweetening Plant: 250-barrels per hour capacity; orifice tube and vertical cylindrical tank arrangement; steam-driven duplex pumps.

7. Lube Oil Batch Treating Plant: Two 1000-barrels agitators; steam-driven pumps and air compressor; (shut down).

8. Tank Car Shipping: 600-foot loading rack; tank car steaming arrangement; steam-driven duplex pumps.

9. Sharples Dewaxing Plant: Capacity 300 barrels bright stock per day; 21 Sharples centrifuges; two 100-ton Carbondale refrigerating machines; steam-heated tanks and steam-driven duplex pumps; (shut down).

10. Contact Filtering Plant: Capacity 440 barrels bright stock per day; Foster pipe still; vapor separator; two clay and oil mixing agitators; two No. 12 Sweetland filters; steam-heated tanks and steam-driven duplex pumps; (shut down).

11. Gasoline Compression Plant: Capacity 1,000,000 feet per day; two gas engine-driven 80 horsepower Cooper compressors; steam-driven Roots vacuum pumps; absorber and treating towers; cooling pond; electric-driven water, caustic and gasoline pumps.

12. Petroleum Coke Briqueting Plant: Capacity 100 tons per day; steam engine-driven coke briquette press; exhaust steam coke drier, bins, conveyors, electric motors.

13. Steam Power Plant: Rated boiler capacity 2800 horsepower; four 500 horsepower Heine boilers; three 267 horsepower Babcock & Wilcox boilers; superheaters; steam turbine-driven centrifugal boiler feed pumps; Cochrane heater and water softener.

14. Electric Power Plant: Capacity 1000 Kva; two 500 Kva turbo alternators, steam turbine-driven; 2200 volt distributing system.

15. River and Reservoir Water System: 600 g.p.m river water system; electric-driven centrifugal pumps and gas engine-driven auxiliary plunger pumps; 2500 g.p.m. recirculating water system; 2500 g.p.m cooling tower; electric-driven centrifugal pumps.

16. Transfer and Loading Pump House: All pumps steam-driven duplex; steam heated building.

17. Air Compression Plant: Capacity 2600 c.f.m.; all air compressors steam driven; steam heated building.

18. Mechanical Shops: Completely equipped carpenter, electric meter, machine, welding, blacksmith, paint, automobile and salvage shops; motor-driven machinery; steam heated buildings.

19. Fire Protection System: Foamite, 90,000-gallon capacity; steam-driven Foamite pumps; steam heated buildings.

20. Tank Car Repair Shop: Fifteen car repair tracks; steam heating, cleaning and inspecting arrangement.

21. Lube Oil Barreling and Blending Plant: Steam-driven duplex pumps; steam-heated drum washing machine and drum drying room; steam heated building.

22. Office of Laboratory: Steam heated building; steam for laboratory service.

### Steam Metered

Steam flow meters are installed on all main lines leaving the boiler house and on all branch lines to and from the various units. This system of measuring the actual steam consumption of the units affords a means of checking the efficiency of the various steam users, and increasing the economy of each machine. The meters have told us that the throttle valves needed reseating, the slide valves needed regrinding, that the turbine blades were dirty or out of adjustment, and of many factors that materially affected the steam economy of the machine. Too much credit cannot be given to meters. We believe them to be essential in every refinery.

| | Pounds Steam Used Per Day | |
|---|---|---|
| | High Pressure | Exhaust |
| 1. Crude stills and tank farm | 130,000 | 250,000 |
| 2. Rerun stills | 40,000 | 78,000 |
| 3. Lube Stills (shut down) | ..... | ..... |
| 4. Dubbs cracking plant | 1,090,000 | 250,000 |
| 5. Light oil batch treating | 20,000 | 20,000 |
| 6. Light oil continuous treating | 20,000 | 20,000 |
| 7. Lube oil batch treating (shut down) | ..... | ..... |
| 8. Tank car shipping | 5,000 | 20,000 |

*Continued on next page.*

*Before technical meeting of the Western Refiners Association, Shreveport, Louisiana, June 4 and 5, 1928.

| | | |
|---|---|---|
| 9. Sharples dewaxing plant (shut down).. | ..... | 10,000 |
| 10. Contact filtering plant (shut down).... | ..... | ..... |
| 11. Gasoline compression plant ..... | 35,000 | 5,000 |
| 12. Petroleum coke briquetting plant ..... | 35,000 | 2,000 |
| 13. Steam power plant ..... | 112,000 | ..... |
| 14. Electric power plant ..... | 362,000 | 2,500 |
| 15. River and reservoir water system ..... | ..... | 5,000 |
| 16. Transfer and loading pump house ..... | 75,000 | 10,000 |
| 17. Air compression plant ..... | 35,000 | 2,000 |
| 18. Mechanical shops ..... | ..... | 40,000 |
| 19. Fire protection system ..... | ..... | 2,000 |
| 20. Tank car repair shop..... | ..... | 30,000 |
| 21. Lube oil barrelling blending plant..... | 8,000 | 10,000 |
| 22. Offices and laboratory ..... | 2,000 | 10,000 |
| 23. Boiler feed water heater..... | ..... | 129,000 |
| 24. Dubbs stills surface condenser ..... | ..... | 245,000 |
| 25. Traps ..... | ..... | 20,000 |
| 26. Waste to atmosphere and to sewer..... | ..... | 808,500 |
| | 1,969,000 | 1,969,000 |

The equipment in the steam power plant, as stated briefly above, consists of: Four 500 horsepower cross-drum water-tube Heine boilers equipped with Foster radiant tube steam superheaters located in the furnace, and automatic feed water control; and three 267 horsepower Babcock and Wilcox water-tube boilers equipped with B. & W. steam superheaters and automatic feed-water control. Gas and oil fuel are available for heat. Gas is used normally. Oil is used in case the gas system gives trouble. The fuel system arrangement is such as to conveniently change from gas to oil without disturbing the load.

Three 200 g.p.m. steam turbine-driven centrifugal pumps deliver feed water to the boiler; one pump acts as a standby. An exhaust steam superheater (capacity 50,000 pounds per hour, 75 degrees Fahrenheit rise) is available for use on process exhaust steam.

### Water System

The source of boiler feed water is the Platte River and the return refinery steam condensate. The cold river water is pumped over two rerun still light gasoline-steam condenser boxes, overflowing by gravity to a 140,000-gallon reserve tank (14 hours reserve), then through a Cochrane feed-water heater, lime-soda ash softener and sand filters. The 200 g.p.m. pumps take suction on the filters and deliver the water to the boilers. A separate duplex pump is used to pump condensate from a concrete hot well to the water softener tank. The raw feed water enters the heater and treater at 100 degrees Fahrenheit temperature, and 8 to 12 grains per gallon hardness. It leaves the plant at 210 degrees Fahrenheit and 0.5 grains per gallon hardness.

The boilers are equipped with individual recording steam-flow meters, draft gauges and a flue gas and steam temperature indicating system. All gas, steam and water entering and leaving the boiler house are metered.

Four 500 horsepower boilers are operated at all times at 180 pounds pressure, 100 degrees Fahrenheit superheat. The B. & W. boilers are used for standby service.

A typical daily operating sheet is as follows:

| | |
|---|---|
| Boiler No. 1—lbs. steam per 24 hours..... | 525,000 |
| Boilers No. 2—llb. steam per 24 hours..... | 536,000 |
| Boiler No. 3—lbs. steam per 24 hours..... | 403,000 |
| Boiler No. 4—lbs. steam per 24 hours..... | 505,000 |
| Operating pressure, lbs. per sq. in..... | 180 |
| Stack draft, in water ..... | 0.25 |
| Stack temperature, degrees F. ..... | 450 |
| Steam temperature, degrees F. ..... | 473 |
| Temperature of feed water, degrees F. ..... | 210 |
| Gallons feed water per day ..... | 241,500 |
| Pounds feed water per day ..... | 2,012,500 |
| Total pounds steam generated ..... | 1,969,000 |
| Blowdown, waste, etc. ..... | 43,500 |
| B.H.P. developed by boilers and heaters ..... | 72,925 |
| B.H.P. developed by boilers ..... | 63,928 |
| Total cubic feet gas burned ..... | 2,234,000 |
| Cubic feet gas per B.H.P. ..... | 35 |
| B.t.u. per cubic foot gas ..... | 1,147 |
| Rated B.H.P. on line ..... | 2,000 |
| Per Cent. rating developed ..... | 133 |
| Boiler and furnace efficiency, per cent. ..... | 83 |
| Total K.W.H. generated by Turbo-alternators ..... | 8,400 |
| Raw water used, gallons per day ..... | 96,500 |
| Return condensate used, gallons per day ..... | 145,000 |
| Total water used, gallons per day..... | 241,500 |

*Treating Plant*

| | |
|---|---|
| Raw water hardness, gr. per gal. ..... | 9.0 |
| Treated water hardness, gr. per gal. ..... | 0.5 |
| Average P.H. reading ..... | 0.9 |
| Average M.O. reading ..... | 2.2 |
| Average $N_a C_1$ ..... | 11.0 |
| Alkalinity ..... | 39.0 |
| Total soda ash used per 24 hours, lbs..... | 84 |
| Total lime used per 24 hours, lbs. ..... | 118 |

(Based on average monthly cost figures)

| | |
|---|---|
| Labor operations ..... | $ 1,173.00 |
| Labor repairs ..... | 600.00 |
| Material operations ..... | 105.00 |
| Material repairs ..... | 300.00 |
| Fuel ..... | 6,700.00 |
| Depreciation ..... | 1,761.00 |
| Water purchased ..... | 450.00 |
| Power purchased ..... | 120.00 |
| Chemicals ..... | 141.60 |
| Total ..... | $11,350.60 |
| Total pounds steam generated ..... | 66 m.m. |
| Cost per 1,000 lbs. to generate ..... | $0.172 |

Note: Gas fuel cost 8 cents per 1,000 cubic feet, and averages 1,150 B.t.u. per cubic foot.

The boiler heating, treating and filtering plant consists of a 16,000 g.p.h. Cochrane feed water heater, a lime-soda ash softener, chemical tanks, two 8,000-gallon-per-hour sand filters, electric driven centrifugal pumps, meters, control instruments, and water testing outfit.

An average analysis of the raw water entering the treating plant shows:

| | Grains per U. S. Gal |
|---|---|
| Calcium carbonate ..... | 2.74 |
| Calcium sulphate ..... | 6.35 |
| Magnesium chloride ..... | 3.20 |
| Silica ..... | 0.70 |
| Iron oxide and alumina ..... | 0.12 |
| Sodium and Potassium sulphate ..... | 2.68 |
| Sodium and potassium chloride ..... | 1.22 |
| Organic and volatile ..... | 1.87 |
| Total solids by evaporation ..... | 18.89 |
| Suspended matter ..... | 1.81 |
| Free acid $CO_2$ ..... | 0.23 |

The cost to treat this water follows:

| | |
|---|---|
| Heating, softening and filtering plant ..... | $20,000 |
| Return condensate system ..... | 5,000 |
| Investment ..... | $25,000 |
| | Gallons |
| Raw water ..... | 96,500 |
| Return condensate ..... | 145,000 |
| Water treated per 24 hours ..... | 241,500 |

*Operating Cost Per 24 Hours*

| | | | |
|---|---|---|---|
| Fixed charges: | | | |
| Depreciation | 10% | | |
| Taxes and insurance | 3% | | |
| Repairs and renewals | 2% | 15% | $8.90 |
| Operating charges: | | | |
| Soda ash, 84 lbs./24 hrs. at $2.50/cwt | | | $ 2.12 |
| Lime, 118 lbs./24 hrs. at $1.29/cwt. | | | 1.52 |
| Electric power, 75 Kwh at $0.15/Kwh | | | 1.13 |
| Total operating cost per 24 hours | | | $13.67 |
| Cost per 1,000 gallons treated water | | | $0.057 |
| Cost per 1,000 gallons raw water | | | 0.143 |

Before the heating and treating system was installed for the feed water, the following costs occurred:

*Cost to Boiler House Due to Hard Low Temperature Water—Cost of One Heine Boiler Cleanout*

| | |
|---|---|
| Material: | |
| Two boiler tubes at $8.23 | $ 16.46 |
| 300 hand hole gaskets at $0.031 | 9.30 |
| One hand hole gasket at $0.758 | .76 |
| 5 lbs. graphite at $0.50 | 2.50 |
| One-half gallon Linseed oil at $1.50 | .75 |
| Lagonda cleaner | 1.00 |
| Water for washing, 20,000 gallons at $0.05 | 1.00 |
| Air for turbines 288,000 cu. ft. at $0.10 | 28.80 |
| | $60.57 |
| Labor: | |
| Two tube cleaners, 8 days at $6.00 | $96.00 |
| Boiler maker, 8 hours at $0.90 | 7.20 |
| Pipe fitters, 16 hours at $0.87½ | 14.00 |
| Superintendence, 8 hours at $0.90 | 7.20 |
| | $124.40 |
| Total cost one Heine boiler cleanout | 184.97 |
| Total cost Heine boiler cleanouts, per month (three cleanouts) | $554.01 |

*Cost of One B. & W. Boiler Cleanout*

| | |
|---|---|
| Material: | |
| One boiler tube at $8.54 | $ 8.54 |
| 200 hand hole gaskets at $0.107 | 21.40 |
| Two hand hole gaskets at $0.758 | 1.52 |
| 8 lbs. graphite at $0.50 | 4.00 |
| Three-fourths gallon Linseed oil at $1.50 | 1.12 |
| Water for washing, 15,000 gallons at $0.05 | .75 |
| Air for turbines, 240,000 cu.ft. at $0.10 | 24.00 |
| | $61.33 |
| Labor: | |
| Two tube cleaners, 6 days at $6 | $ 72.00 |
| Boiler maker, 6 hours at $0.90 | 5.40 |
| Pipe fitter, 12 hours at $0.87½ | 10.50 |
| Superintendence, 6 hours at $0.90 | 5.40 |
| | $93.30 |
| Total cost of one B. & W. boiler cleanout | $154.63 |
| Total cost, B. & W. boiler cleanout per month (one cleanout) | 154.63 |
| Cost Heine and B. & W. boiler cleanout per month | 708.64 |
| Cost Heine and B. & W. cleanout, per day | 23.62 |
| Cost of water per day due to blow-down 4 per cent. total water used: (241,500 gals./24 hrs. x 4%=9,660 gals. at $0.20 per 1,000 gals.) | 1.93 |
| Cost per day of fuel due to scale formation | 11.52 |
| Cost per day of fuel due to "cold" water (180 degrees Fahrenheit) | 3.70 |
| Total cost to boiler house per day due to hard, low temperature water | $40.77 |

The saving in the present boiler house operation due to the feed water heating and softening system, can be calculated from the costs that are now effective.

| | |
|---|---|
| Total cost to boiler house per day (from above) | $ 40.77 |
| Present cost to treat feed water | 13.67 |
| Cost for Heine and B. & W. cleanout per day | 7.87 |
| Cost of water per day due to blowdown | 1.20 |
| Cost per day of fuel due to scale formation | 2.50 |
| Total present cost per day | $ 25.24 |
| Saving per day over previous operation | 15.53 |
| Saving per year over previous operation | $5,668.45 |

The above economy does not include many factors which cannot be readily calculated, such as:

Decreasing the mechanical difficulties in the boiler house due principally to scale.

Increasing the rating of the boilers.

Increased efficiency in the steam system due to operating at a higher steam pressure. The heating and treating plant allows the B. & W. low pressure (160-pound) boilers to be taken off the line and to operate the Heine boilers at 180 to 200 pounds pressure.

### Exhaust Steam

The refinery has two complete exhaust steam systems operating under 15 pounds and 5 pounds pressure.

All steam-driven turbines exhaust into the 15-pound headers and this steam is used for process and heating. Gathering mains and distributing headers are installed over the entire plant and tank farm. The electric power house and the Dubbs cracking plant turbines provide the bulk of this steam. It is used principally in the crude and re-run stills, tank farm storage, and for heating buildings. No high pressure steam is used for any service except power, or in rare instances when a higher temperature for heating is required than can be supplied by the 15-pound exhaust.

The tank farm is a large user of steam due to the high cold test crude and products handled. At one time in the refinery operation 400 B.H.P. of high pressure steam was used continually throughout the winter months for maintaining the oil in these tanks at a mobile temperature.

In order to use exhaust steam in the storage and working tanks larger than 5000 barrels capacity, it was necessary to revise the steam coils. In brief, the design used was, exhaust steam lines enter the tanks in the bottom ring and connect inside to a header, the header having 2-inch branch lines that in turn enter 6-inch pipes the length of the tank diameter and less according to the curvature of the shell, forming a 2-inch by 6-inch double pipe arrangement. The steam travels through the 2-inch pipes, emits at the far end of the 6-inch pipe and returns through the 6-inch pipe toward the first entrance, discharging the condensate into a 2-inch header. All double pipe branch lines are straight and on the same plane. Expansion is cared for by anchoring the end at the headers. The pipe is supported on steel pipe horses.

The principal feature of the type coil described is that expansion and water hammers, the demons in steam coil design, are taken care of. The coil is welded wherever possible. When flanges were used they were made extra heavy; lock washers were put on the bolts, and the pipes anchored to take all strain from the flanged connections. The coils have been in service a year and are in perfect condition.

### Tank Heating

For the 55,000-bbl. uninsulated steel tanks, there was in-

stalled 1500 square feet heating surface of 6-inch pipe, 10 lengths 90 feet long.

For the 7500-bbl. uninsulated steel tanks, there was installed 270 square feet heating surface of 6-inch, six lengths 27 feet long.

At various places in the refinery we were using a line that was common for steam smothering and heating service. In places where the line was used for heating we found that it would be better to eliminate the high pressure steam and manifold the line with exhaust steam in such a way that the exhaust steam could be put into the line for heating and by a check valve arrangement, high pressure steam could be put into the line should smothering steam be desired during a fire.

The 5-pound exhaust steam system is in service on all steam duplex pumps, air compressors, engines, and all machinery using cylinder oil for lubrication in the steam cylinders. This is a dirty steam and is therefore kept in a separate system apart from the process units steam. The The refinery machinery of the above type uses just about the amount of steam required for heating the boiler feed water; therefore, the 5-pound is discharged through an oil separator to the Cochrane feed water heater. Gathering mains are installed over the entire refinery, collecting all of the exhaust steam from pumps and engines.

The exhaust steam production and demand is very well balanced.

The steam power plant uses for boiler feed water about 242,000 gallons per day. The raw or make-up water is pumped from the Platte River, a distance of 6 miles, and at a cost of 18 cents per 1000 gallons. The source of supply is very unsatisfactory due to the high turbidity and hardness of the water, and the limited capacity of the pumping system. Of the 600 g.p.m. delivered only about 50 per cent is available for refinery use. The remainder goes to the city of Parco. The city is growing and is consuming more water every year, thereby decreasing the amount available for refinery use and making economy in water a necessity in the refinery.

### Condensed Steam

Condensed steam is a premium feed water in any industrial plant, and especially so at Parco. It herefore became a kind of mania to get as high a percentage of return condensate as possible to the boiler house hot well. At present this return has reached 60 per cent of the total water used. This figure is not considered the maximum attainable. The percentage of condensate return could be materially increased if the refinery electric power load, generated by steam turbine-driven generators, did not have such an intermittent change caused by outside distribution to the city of Parco and outside industries.

Gathering lines are run from the tank farm and from all of the process and mechanical units to the boiler house hot well. Whenever a new steam service is installed in the plant it is a fixed rule to gather the exhaust steam and the return condensate where at all possible.

Strong steam traps are used on all steam lines and steam coils. As there are about 100 steam traps in the plant, one operator is assigned to their upkeep. This operator also repairs steam valve leaks and works on general maintenance of the outside steam system.

At the Dubbs stills an 800 square foot surface condenser was installed for use on the Lientz turbines and Dow hot oil pumps. The condenser serves a two-fold purpose, in reducing the high pressure steam consumption of the turbines and pumps by exhausting to amospheric pressure rather than to a back pressure; and in condensing the surplus exhaust for boiler feed water. The condenser was built by the refinery shops out of a salvaged 4-foot diameter by 18 feet long heat exchanger shell and 14-square-foot cast iron Sterling sections. A satisfactory heat transfer is obtained. The condenser piping is so arranged that the exchanger can be cut back to exhaust line if necessary.

The steam power plant and the steam distributing system in the petroleum refineries, especially in the smaller plants, are units very often neglected.

At one time the Parco refinery steam power plant developed 2,500,000 pounds of steam per day at a cost of $27,000 per month, compared with the present operation of 2,000,000 pounds per day at a cost of $11,350 per month. Four boilers now easily do the same work that seven were formerly made to do, allowing three dead boilers for standby service.

The above economy was effected principally due to putting the steam plant under engineering supervision, employing a capable steam power plant foreman, changing from oil fuel to gas fuel resulting in increased efficiency of the boilers, and making such improvemnts as the exhaust steam system, condensate return system, and installing the boiler feed water heating and softening plant.

The load in 1926 was 2,500,000 pounds of steam per 24 hours. If the exhaust system had not been installed we would now have a load of about 3,100,000 pounds per day due to the added load, such as the Dubbs stills steam turbine-driven Lientz recirculating fans, Dow reflux pumps, increased oil throughput, addition of the briquetting plant, etc.

In 1926 the boilers were evaporating a pound of steam with 1.49 cubic feet of gas, (converting the fuel through a B.t.u. basis into gas to make comparable). 1.49 times 3,100,000 equals 4,620,000 cubic feet of gas per day or 144,000,000 cubic feet of gas per month. We used in January, 1928, 84,413,000 feet of gas. The saving is 60,000,000 feet of gas at 8 cents per 1000 or $4,800 per month for gas alone, not to mention a saving in the cost of water, charges on equipment, cleaning, etc.

We can conservatively say that the saving to the the boiler house due to the economies mentioned is $80,000 per year.

The boiler house is now operating at a fair efficiency, 83 per cent. This we believe to be within a few per cent of the maximum that can be attained with the present equipment and without economizers. It is our purpose to improve the water treatment, reducing the hardness to less than 0.5 grains per gallon, and to further decrease the steam demand in the operating units.

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A. J. L. Hutchinson, well known research engineer, has resigned from the Standard Oil Company of California and associated himself with the Engineering, Research & Equipment Company of Los Angeles and Dallas, as research engineer.

Mr. Hutchinson is a graduate of Stanford University. From the time of his graduation in 1919 until December, 1921, he was with the United States Government, located at the Helium plant at Petrolia, Texas; Standard Oil Company of California, Wallace Refineries, Taft; and Wallace and Brooks, Breckenridge, Texas. During 1922 he was employed as research chemist for the Midwest Refining Company at Salt Creek, Wyoming. During 1923 and until April, 1924, Mr. Hutchinson was at the California Institute of Technology, doing research work on gas analysis. In April, 1924, he was employed on research work by the Pacific Gasoline Company. When this company was purchased by the Standard Oil Company of California, Mr. Hutchinson was transferred to the Research and Development Department of the Standard Oil Company. His broad experience in reasearch work and plant design, along the lines required for gasoline plant and fractionation work, will be of great value to both company and clientele.

# Recovery of Gasoline From Field and Refinery Gases*

By ION EDELEANU
*A. C. G. I., B. Sc. (En'g), D. I. C., (Member)*

THE IMPORTANCE of the recovery of gasoline from field and refinery gases is now recognized everywhere. The progress in number and efficiency of gasoline recovery plants is well known to you. The rate of increase in the amount of gasoline recovered from field and refinery gases is much ahead of the rate of increases of crude oil production.

For this year (1927) it is estimated that the natural gasoline industry of the United States will produce approximately 1,600,000,000 gallons from natural gas and approximately 340,000,000 gallons from uncondensed still vapours, giving a total of 1,940,000,000 gallons or 4,850,000 metric tons of gasoline, i. e., a daily production of approximately 5,400,000 gallons or 13,460 metric tons.

The production of gasoline from field and refinery gases is greater in the United States than the crude oil production in Rumania.

The above figures of 13,460 metric tons of daily production in the United States represents 5.2 per cent., by volume, or 4 per cent. by weight, of the corresponding crude oil production in that country. At first glance 4 per cent. is not a striking figure but if we assume that the price of gasoline, on weight basis, is 3½ times higher than the price of crude oil, then we realize that the recovered gasoline represents 14 per cent., by value, of the crude oil. In order to attain corresponding figures in Rumania—i. e., a gasoline production of approximately 410 tons per day—the minimum installed capacity of gasoline recovery plants should be about 520 tons per day, (420 tons for field gases and 100 tons for uncondensed vapours in refineries). Unfortunately, natural gasoline production here in Rumania is still in its infancy. Furthermore, it should be noted that in general the natural gasoline industry has not yet attained its highest possibilities. Two new factors contribute to its further development. These factors are:

(a) The system of air and gas lift of crude oil, which augments and regulates the available gas for gasoline recovery;

(b) Improved methods in handling and storing, resulting in the maintenance of a higher percentage of volatile fractions in the crude, which fractions can not all be condensed with the ordinary refinery equipment. Therefore, there is an increasing necessity for the recovery of uncondensed still vapours.

There are three main processes employed by the natural gas industry:

The Compression Process,
The Absorption Process and
The Activated Charcoal (Adsorption) Process.

The first named two processes are older and better known. They have their advantages and limitations. The Charcoal Process is of more recent date and its development during the last years has been remarkable.

The object of this paper is to describe the activated charcoal process of gasoline recovery, and especially the Carbo-Union-Bayer-Process.

The absorbent medium "activated charcoal" is a composite material which chemically is characterized by a very high content (about 90 per cent.) of carbon and physically is characterized by a great internal surface development compared to its mass. In other words, the activated charcoal is a structure of capillaries with a notably great surface. If the capillaries of such a charcoal would be of the same size and would all have a diameter of one millimikron, then the inside capillary surface of a cube of one centimeter base would total about 6000 square metres. Ordinarily, the activated charcoal has capillaries of different sizes varying from one millimikron upwards and the inside capillary surface of a cube of one centimeter base is estimated to be about 600 square metres (6500 square feet). Such highly porous bodies possess the property of adsorbing gases and vapours.

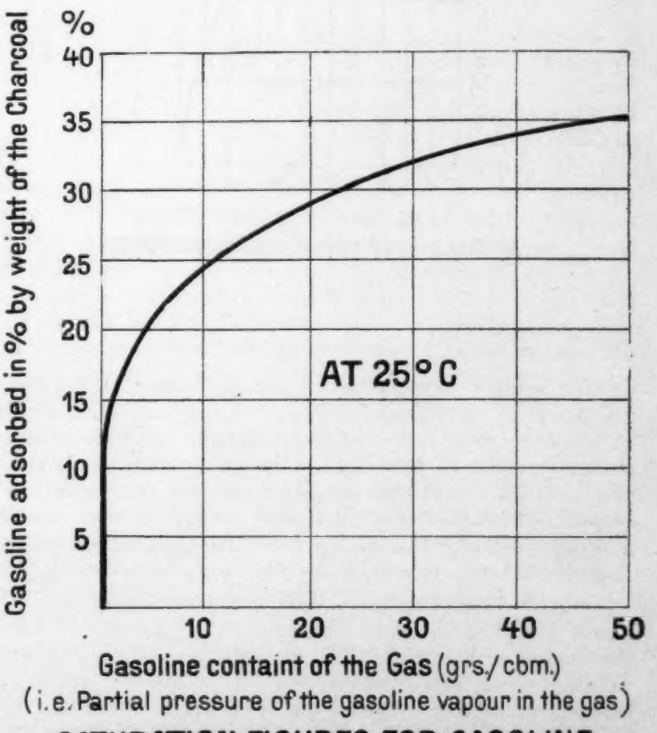
In fact, it is assumed that two phenomena take place:

(1) The covering of the surface of the capillaries with a one molecule thick layer of gas; and

(2) The filling of the capillaries with condensed vapours.

The first phenomenon depends upon, and is proportional to the surface; the second phenomenon which quantitatively is much more important, depends upon the inside capacity of the capillaries. Gases which can not be condensed (being above their critical temperatures) will undergo only the first phenomenon, but those vapours which are below their critical temperature and hence can be condensed will be absorbed to a greater extent because they will also undergo the second phenomenon, i. e., condensation and filling of the capillaries.

The charcoal has a lowering effect on the vapour tension of the adsorbed liquid. The adsorption depends upon the difference in vapour pressure of the condensed liquid in the capillaries of the charcoal and the partial pressure of the




**SATURATION FIGURES FOR GASOLINE ADSORPTION IN ACTIVATED CHARCOAL**

*Figure* 1

(*) Paper read before the Rumanian Branch of the Institution of Petroleum Technologists on December 16, 1927.

vapour in the gas. The activated charcoal will adsorb and condense greater quantities of vapours if such vapours are present in greater concentrations in the gas: because in this case the difference in the vapour pressure of the liquid in the capillaries and the partial pressure of the vapour in the gas is greater. Similarly, the adsorption capacity of the charcoal decreases at higher temperatures: because the vapour pressure of the condensed liquid in the capillaries will be raised and hence the difference between this pressure and the partial pressure of the vapour in the gas will be reduced.

The adsorption is very rapid in the beginning of the process, slows up, however, as and when the charcoal becomes more saturated and ceases when the pressure of the condensed liquid in the capillaries equals the partial pressure of the vapour in the gas.

Diagram in Figure 1 shows the percentage, by weight, of gasoline adsorbed by the Bayer activated charcoal at 25 degrees C. temperature as a fraction of the content of gasoline in the gas or better said as a function of the partial pressure of the gasoline vapour in the gas. Hereafter we shall call charge the percentage by weight of the adsorptive in the adsorbens, and, we shall call saturation the charge beyond which the charcoal kept at a definite constant temperature, will no longer adsorb gasoline from a gas containing in a definite proportion these vapours. The saturation figures correspond to definite partial pressures of the gasoline vapour and to

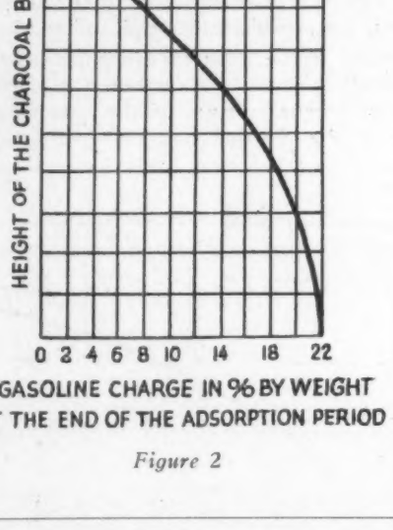



*Figure 2*

definite constant temperatures of the adsorbens. Such figures are plotted in the diagram of Figure 1; they are obtained only in laboratory tests, pursuing the experiment until the limiting charge (saturation) has been reached through the whole charcoal bed. In practice the charge is always less than the corresponding balanced saturation and is not uniform, having a greater value at the inlet side of the gas and decreasing towards the outlet side as shown diagrammatically in Figure 2.

Figure 3 shows diagrammatically the structures of two different kinds of activated charcoal. The samples of these charcoals have been selected to have the same sizes of grains, so there is not much difference in the volume of the voids between the grains. There is a considerable difference between the volume of the solid carbon substance, which is due to the fact that the first charcoal is made from peat and the second one is made from fruit pits. It will be readily understood that neither the voids nor the solid substance will act in the adsorption process. The balance of the volume is

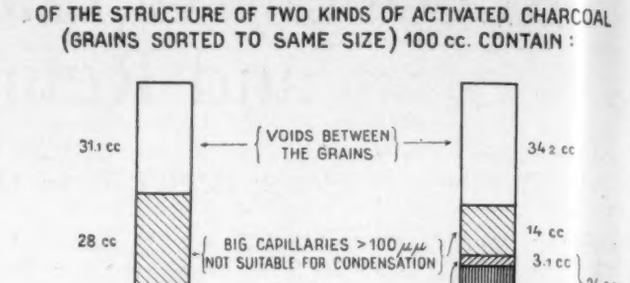



*Figure 3*

the volume of the capillaries. These capillaries are classified according to size into the following three categories:

(1) Capillaries bigger than 100 millimikrons.
(2) Capillaries between two and 100 millimikrons.
(3) Capillaries smaller than two millimikrons.

While the first category of capillaries are too large and therefore useless for condensation, the second and third categories are suitable for this purpose. Capillaries of more than two millimikrons can condense vapours only when they are present in a certain high concentration in the gas, i. e., their partial pressure is great, whereas capillaries of less than two millimikrons — category (3) — will condense vapours even if such vapours are present only in a very small proportion in the gas.

The total volume of the capillaries up to 100 millimikrons has been determined by the quantity of benzol adsorbed from a gas saturated with benzol vapours, whereas the total volume of the capillaries up to two millimikrons has been determined by the quantity of benzol adsorbed from a gas only one-tenth saturated with benzol vapours. The difference of these two figures gives the total volume of the capillaries of the size between two and 100 millimikrons.

The quantitative proportion between the two last mentioned categories of capillaries is a criterion whether such charcoal is better suited for the recovery of solvents in relatively high concentration or for the adsorption of gases. Extensive research work in this field has been carried out, under Prof. Mecklenburg's direction, in the laboratories for anorgenic

*Figure 4*

chemistry of the *Verein fuer chemische und metallurgische Produktion.*

In conclusion it can be stated that the quality of an activated charcoal depends:

(1) On the development of inside capillary surface per unit of weight.
(2) On the capillary volume per unit of weight.
(3) On the diameter of the capillaries.
(4) On the chemical character of the surface.

The above named conditions can be adequately combined and proportioned only by a difficult manufacturing process. There are two main methods used at present in the manufacture of activated charcoal. In the first method the process is carried out in two steps: in the first step the raw material—in this case cocoa nut shells — is carbonized and in the second step it is activated under steam treatment of about 1000 degrees C. In the second process the carbonization and activation is conducted simultaneously; the raw material is first impregnated with a strong watery solution of zinc chloride (or another activating substance) and then the process is conducted at about 500 degrees C. The first process is a gas activation process, whereas the second may be considered as a chemical activation process.

The remarkable properties of the activated charcoal ex-

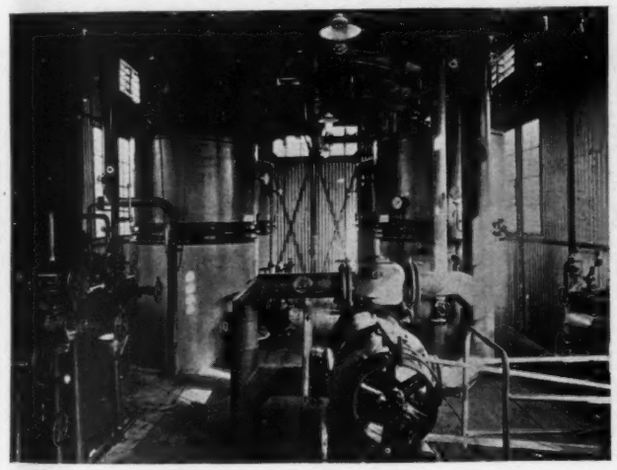


*Figure 5*

plain why gasoline adsorption plants using this material are so compact. The transportable plant, recently put into operation by the Rumanian Consolidated Oilfields (Phoenix Oils) is a striking example. This plant, as shown in Figures 4, 5 and 6, has a daily production of seven metric tons (2800 U. S. gallons) of gasoline but weighs only 60 tons, building and supporting frame included. Figure 7 shows section and plan of a Charcoal Adsorption Plant. Figure 8 shows a plant with a daily capacity of 20 tons gasoline.

The principal parts of a charcoal gasoline plant are:

(A) Filter for removing the impurities contained in the gas (dust, oil, etc.).
(B) The adsorbers filled with activated charcoal.
(C) The condenser and cooler for the distilled vapours.
(D) The gasoline and water separator.
(E) The blower for the drying and cooling air.

These parts of an activated charcoal plant are shown diagrammatically in Figure 9.

The gas first passes through the filter (Figure 9, A) where the impurities, such as dust, oil, etc., are retained. The gas leaving the filter enters one or several adsorbers (Figure 9, B). The cycles are scheduled so that the adsorption periods in the different adsorbers are evenly overlapping, and also so that the rinsing periods are distributed at equal time intervals and do not coincide in two adsorbers at a time. The gas enters the bottom and passes upwards through the adsorbers

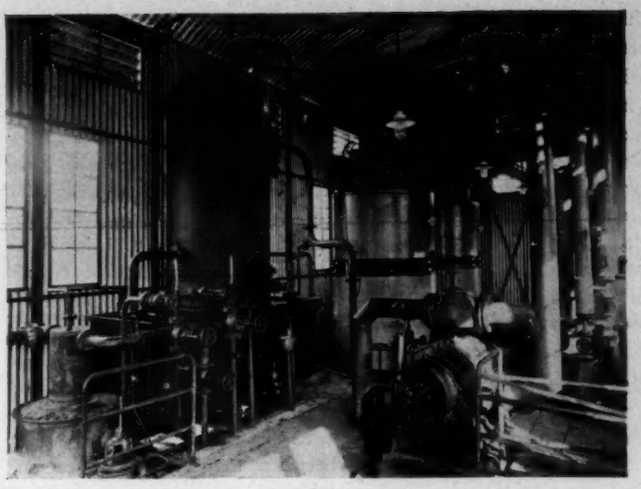


*Figure 6*

so that the lower layers of the charcoal bed are charged first with gasoline. The height of the charcoal bed, in which the adsorption process takes place, is called the "adsorption zone." Theoretically in the adsorption zone, the charge of the charcoal decreases in the flow direction of the gas from 100 per cent. of the saturation (corresponding to the partial pressure of the gasoline vapours) to 0. The charging of the charcoal is accomplished by liberation of heat. The temperatures shown by the three thermometers at the bottom, middle and upper part of the adsorber indicate the travelling of the adsorption zone, and hence the progress of the process of adsorption. The travelling speed of the adsorption zone is function of: (a) the flow speed of the gas, (b) the gasoline content of the gas, (c) the corresponding saturation figure for the charcoal, and (d) the apparent (bulk) density of the charcoal. This speed is expressed in cm/hour by the following formula:

$$0.36 \frac{a \times b}{c \times d}$$

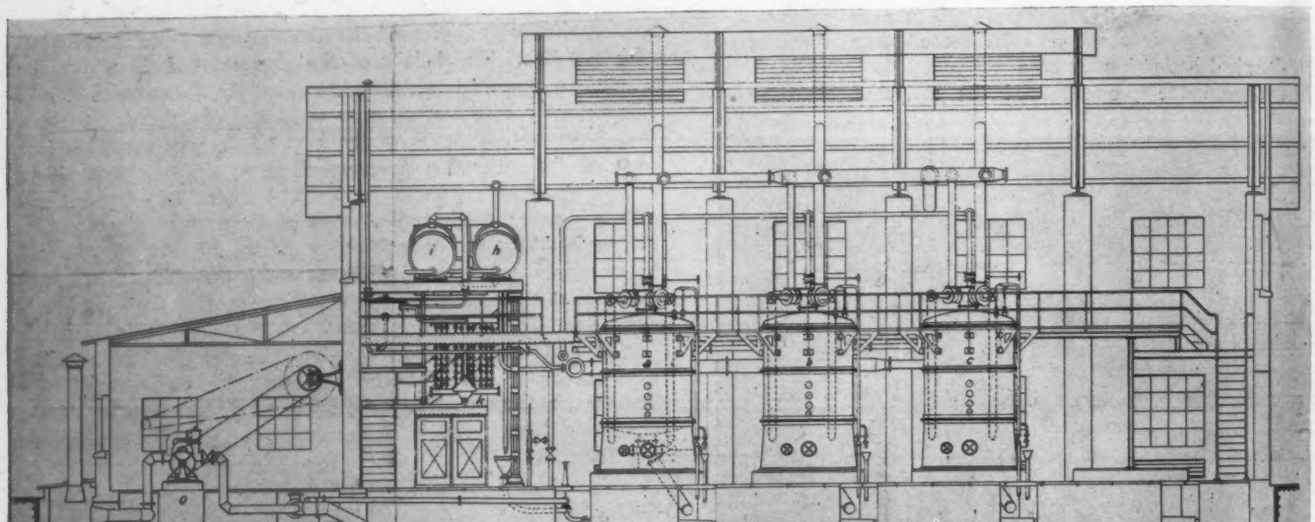
(a being cm/sec.; b being grs/cbm; c being per cent. by weight; d being grs/cc.). The above expression gives higher values as obtained in practice, where the phenomenon is much more complicated, and the speed is influenced by a number of other factors. The presence of moisture in the charcoal and in the gas, acts on the process in a retarding way. Likewise the fact that the gasoline consists of a mixture of hydrocarbons, of which the heavier in being adsorbed drive out the lighter ones, this double process requires a longer time. Fundamental researches to determine the behaviour of the adsorption phenomenon, under a wide range of conditions, have been carried out under the direction of Prof. von Halban in the Physical-Chemical Laboratories of the Metallbank, and the results obtained have greatly improved the efficiency of modern plants.

The charcoal manifests in a high degree the property of selective adsorption, the heavier gasoline fractions displacing and removing the adsorbed lighter fractions. Thus methane which in the beginning is likewise adsorbed by the charcoal, is displaced by ethane, which in turn is being displaced, as and when the charcoal gets more charged, by propane, and so forth. For each constituent hydrocarbon of the gasoline corresponds, so to say, a separate adsorption zone. The adsorption zones of the lighter hydrocarbons are driven in the direction of the flow of the gas, thus the degree of charge and the quality of the adsorbed gasoline is different at different heights of the charcoal bed. The charge of the lower layers is more near to the saturation figures, and the gasoline fraction adsorbed in these layers is heavier than the gasoline fraction adsorbed in the upper layers.

When the adsorption zone of a lighter fraction breaks out

through the surface of the charcoal bed, i. e., when the "break point" for this fraction has been reached, such lighter fraction will begin to pass in the residual gas. As the process continues, the gasoline content of the residual gas will be steadily increased and the specific gravity of such lost gasoline will also be steadily raised. It would be a logical procedure to stop the adsorption period at the break point of the lightest fraction we want to maintain in the gasoline; but in practice this cannot be carried out so precisely because the fractions of gasoline are all soluble in each other, and therefore the phenomenon of selective adsorption is not so sharp, although sharp enough for practical purposes.

In practice, the mean charge of the charcoal at the end of the adsorption period is 12 per cent. to 16 per cent. This figure is much below the theoretical saturation figure under the same condition of partial pressure of the gasoline vapour in the gas. The difference between theoretical "saturation" and practical "charge" of the charcoal deserves a more thorough explanation. In Figure 10 an adsorber is shown diagrammatically and on its right several curves are plotted, representing the charge in per cent. by weight, at different heights of the charcoal bed. The curve (A) in Figure 10 shows the theoretical saturation, say 35 per cent., which would correspond to a gasoline content in gas of 50 grs/cbm. and to a charcoal temperature of 25 degrees C. Such a saturation would be obtained in a laboratory by slowly passing the gas, until the limiting uniform charge has been attained on the whole height of the charcoal bed. In practice the gas is passed quicker, and in order not to lose gasoline in the stripped gas, due allowance must be made for the length of the adsorption zone, and therefore the adsorption period is stopped when the upper part of this zone has reached the surface layer of the charcoal bed; and taking into account the length of the adsorption zone, we would obtain a charge as represented by the curve (B) in Figure 10. In practice the charcoal gets heated through the adsorption heat, and this heat is carried ahead



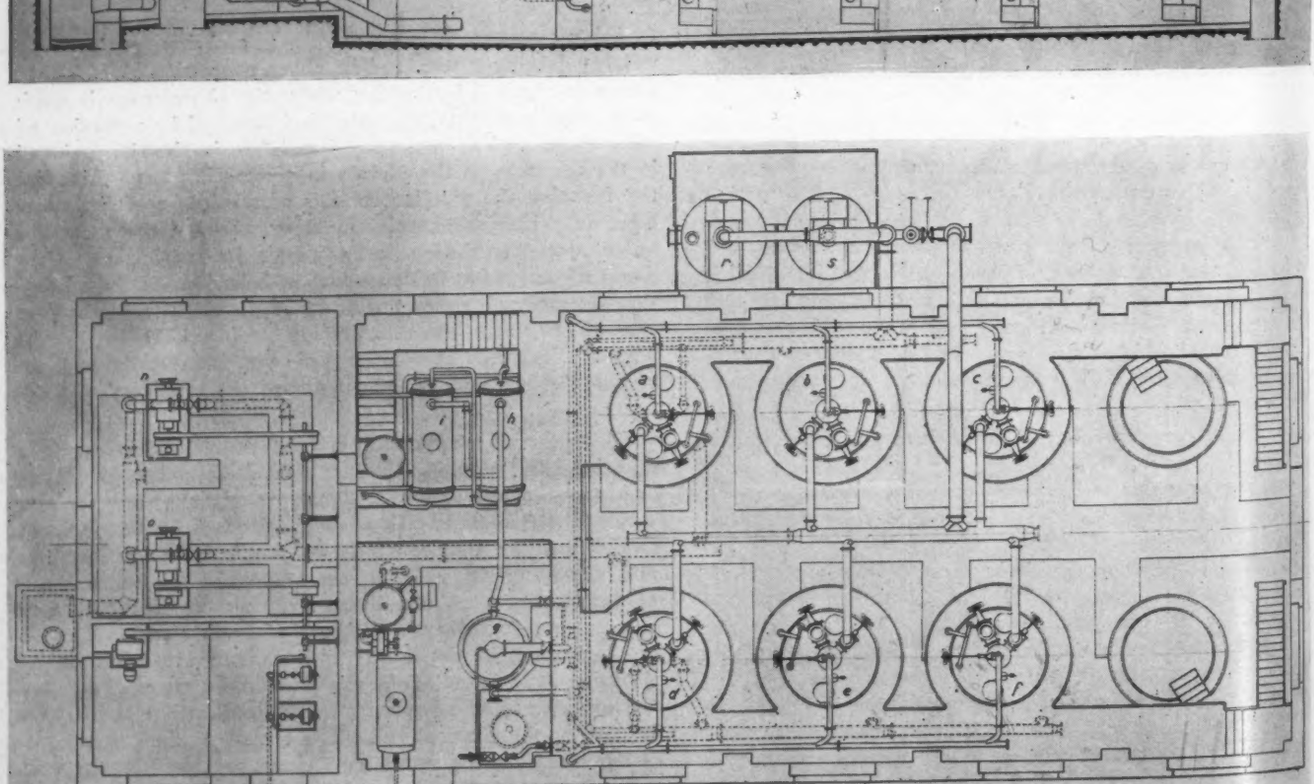


*Figure 7*

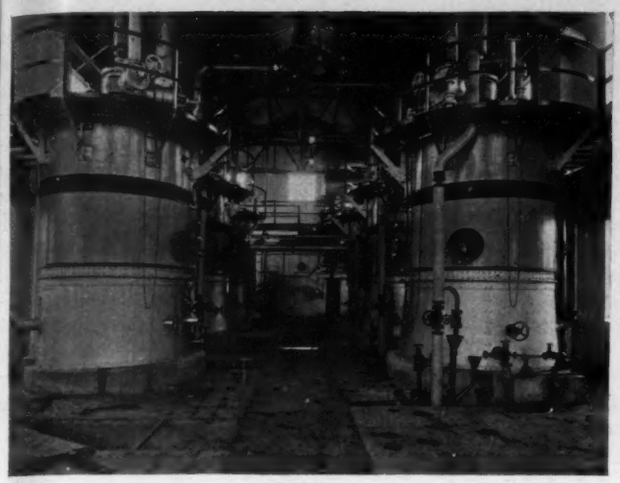


*Figure* 8

of the adsorption zone by the gas. The temperature factor acts also in lowering the charge, and taking into account also this factor curve (C) is obtained. Two other factors contribute to further lowering the charge and these are the moisture in the gas and the residual moisture in the charcoal, and the surves (D) and (E) represent the charge, taking into account also these factors. This last curve (E) is function of the above-mentioned factors, and of the quality of gasoline that it is desired to obtain. The surface which it encloses, divided by height, gives the mean charge of the charcoal at the end of the adsorption period, and in practice, as said above, this charge is only 12 per cent. to 16 per cent., against corresponding saturation figure of 35 per cent. to 38 per cent.

The heat liberated during the adsorption process consists of: heat adsorption and latent heat of condensation of the condensed vapours. To one kilogram of gasoline vapours adsorbed and condensed in the capillaries corresponds a liberation of approximately 140 calories. The temperature of the charcoal would be raised considerably if a good deal of heat were not carried away with the residual (stripped) gas. If the gas is rich, i. e., if the gasoline content is great, cold water is circulated through the coils during the adsorption period and the temperature maintained under 50 degrees C.

When the desired limit of charge is reached in one of the adsorbers, the gas is turned off and indirect steam is passed through the coils. The steam used for indirect heating has about 2½ At. pressure and a temperature of about 127 degrees C. This indirect heating is not sufficient to eliminate the adsorbed gasoline. After a short period of indirect heating the charcoal is rinsed or flushed downwards with direct steam, thus effecting the elimination of the adsorbed gasoline. This process deserves a more detailed description:

Whereas theoretical calculations and laboratory experiments have shown that very large quantities of *statically* applied steam are necessary to recover the adsorbed vapours in the charcoal, it is gratifying to note that the quantity of direct steam required in modern gasoline plants for rinsing out one kilogram of gasoline does not exceed 2½ kilograms. The difference is due to the fact that dynamically applied steam (rinsing) produces another effect than statically applied steam. Indeed, during the process of regeneration the rinsing steam carries away the extracted gasoline vapours so that the most discharged charcoal layer comes into contact with fresh steam in which the partial pressure of the gasoline vapours is practically zero, and therefore the regeneration of the charcoal (i. e., extraction of gasoline therefrom) can be pushed so far that the residual charge of the charcoal corresponds to a gasoline vapour partial pressure of nearly zero. On the other hand, the rinsing steam gets charged with gasoline vapours so that the bottom layers of the charcoal remain well saturated with gasoline until towards the end of the regeneration period. In this way the vapour mixture leaving the adsorber has a high concentration of gasoline vapour until end of the rinsing process.

An important progress was achieved in the economy of the rinsing steam by the Ejector-Vacuum-Evaporator by which a noteworthy part of the latent heat of condensation of the steam and gasoline vapour mixture is recovered. The Ejector-Vacuum-Evaporator (Figures 11 and 12) is an apparatus consisting of a tubular heat exchanger (Figure 11, e), of an evaporation chamber (Figure 11, b) and of a steam ejector (Metallbank-Josse-Gensecke) (Figure 11, c). The Ejector-Vacuum-Evaporator is placed (See Figure 11) on the line for steam and gasoline vapour mixture leading to the condenser so that the steam and gasoline vapour mixture gives up a great part of their latent heat of condensation to the vacuum evaporator instead of loosing it in the condenser. This heat raises the temperature of the water in the chamber of evaporation to about 80 to 85 degrees C. If at these temperatures the pressure is reduced to approximately 0.55 At. the water boils. The ejector (Figure 11, c) brings about in the evaporation chamber the required degree of vacuum which is automatically regulated to correspond to the temperature in the evaporation chamber and to cause the water to boil.

The advantages of this apparatus are obvious: nearly half of the direct steam is saved by regeneration, the condensing equipment of the plant thus being reduced, the cooling water consumption of the condenser is diminished and the feed with rinsing steam is regulated automatically. Indeed, to ensure a proper operation it is necessary that the rinsing should be carried on progressively. The ejector vacuum evaporation now regulates automatically what otherwise could have only been done by hand regulation of the steam valve. At the beginning, the quantity of rinsing steam is limited to the feed steam of the Ejector, and the regenerated steam is produced only gradually as the mixture of steam and gasoline vapours reaches the vacuum-evaporator and heats the water therein.

After the rinsing of the charcoal has been completed, the direct steam is turned off though still leaving on the coil steam, and air is blown through the adsorber, generally upwards. This air gets heated by the hot coils and dries the charcoal. When the charcoal has reached the desired state of dryness the coil steam is turned off while the air continues to pass through the adsorber and cools the charcoal. In order to speed up the cooling of the charcoal sometimes it is found advantageous to circulate cold water through the coils. The humidity of the charcoal at the end of the rinsing period, drying period and cooling period is represented graphically in

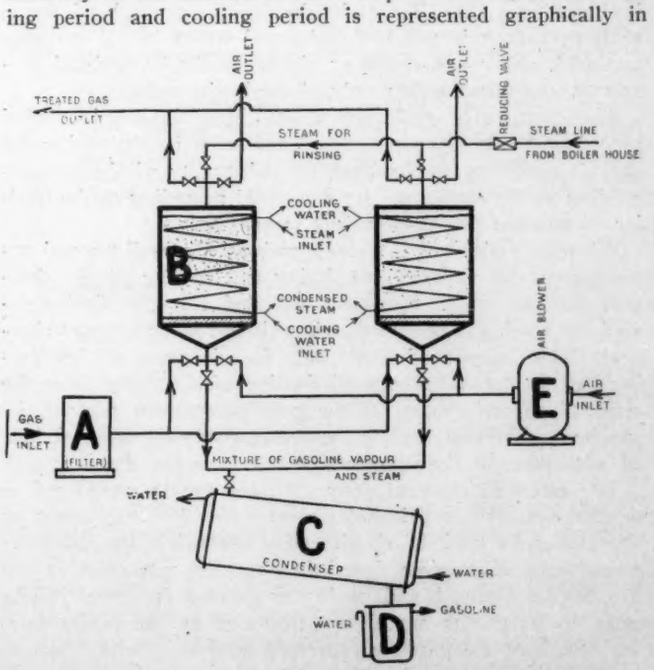



*Figure 9*

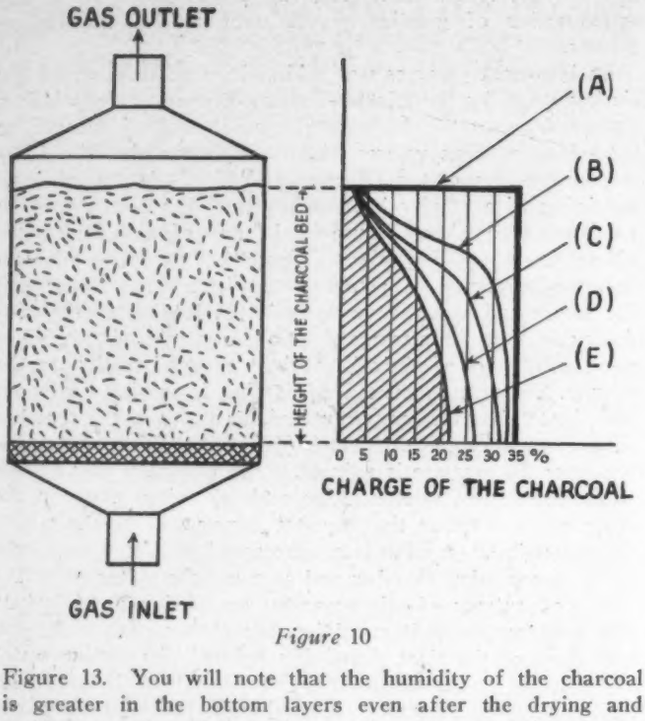



*Figure* 10

Figure 13. You will note that the humidity of the charcoal is greater in the bottom layers even after the drying and cooling periods. This is due to the cold air which carries into the adsorbers humidity which is then adsorbed by the bottom layers of the charcoal. Now the activated charcoal in the adsorbers is ready for a new cycle and the raw gas is switched in again. It should be observed that during the entire process the activated charcoal never gets heated above 140 degrees C. Nevertheless, the extracted gasoline sometimes has a distillation endpoint as high as 160 degrees C. This is due to the fact that the rinsing steam does not act simply, as in a distilling process, but gives, on the one hand, enough heat to the charcoal to balance the adsorption and evaporation heat of the gasoline, and, on the other hand, creates an atmosphere in which the partial pressure of gasoline is practically zero, thereby forcing out the adsorbed gasoline from the charcoal.

For a better understanding of the operation, a plant with six adsorbers and four hours cycle is taken as an example. The duration of each period of the cycle is represented graphically (Figure 14). For each adsorber the upper band represents operations in which the charcoal comes into direct contact with either gas, steam or air, while the lower band represents operation acting only through the coils.

The example of cycle shown in Figure 14 can be varied according to the circumstances, lengthening or shortening the periods according to the quantity and quality of the gas, according to the quality of the steam and according to the quality of gasoline that it is desired to produce.

When very rich gas is treated, such as e. g. well trapped uncondensed still vapours, the drying and cooling of the charcoal with air can be dispensed with and after the rinsing period the fresh gas is immediately switched in on the wet charcoal. This procedure has not only the advantage of time saving but, by a simultaneous elimination of the water from the charcoal and adsorption of the gasoline vapours, part of the gasoline adsorption heat is compensated by the negative heat of adsorption of the water eliminated from the charcoal.

The activated charcoal recovery plant can be considered as a very sensitive rectification plant and by lengthening or shortening the periods of adsorption practically the exact required cut of gasoline from the fractions contained in the gas can be obtained, and, as in this process the lower boiling point hydrocarbons are always displaced by the higher boiling fractions, the gasoline recovered is free of wild fractions and further "stabilization" is rendered unnecessary.

It should be noted that the gasoline recovered from field and refinery gases has a great value for blending because it improves volatility and reduces the tendency to knock of such blended motor fuels. The recovered gasoline consists mainly of low boiling paraffene hydrocarbons (butane, pentane, hexane, heptane) and it is now demonstrated that such paraffene hydrocarbons have a high anti-knock value. The blending should be done in a judicious way taking always into consideration the quality of the available recovered gasoline, as well as the required quality of the finished motor fuel. Great progress has been achieved lately in this direction by blending the gasoline recovered from field and refinery gases with special cuts of straight run benzine.

How necessary it is to handle each case individually, can best be judged from the Engler-Distillation results of the three different kinds of recovered gasoline given below:

| | 1 | 3 | 3 |
|---|---|---|---|
| Spec Grav. 15°C | 0.662 | 0.635 | 0.697 |
| I. B. P. | 27°C | Less than 25°C | 33°C |
| 30°C | 15% | 28.5% | .... |
| 40 | 18 | 46 | 3% |
| 50 | 39 | 59 | 15.5 |
| 60 | 55 | 68 | 29.5 |
| 70 | 64 | 75 | 39.5 |
| 80 | 71 | 79.5 | 50 |
| 90 | 78 | 83 | 60 |
| 100 | 84 | 86 | 70.5 |
| 110 | 88 | .. | 78 |
| 120 | 92 | .. | 85 |
| 130 | 95 | .. | 90 |
| 140 | 96 | .. | 93.5 |
| 150 | .. | .. | 95.5 |
| 160 | .. | .. | 96 |
| F. B. P. | 143°C | 103°C | 163°C |
| Residue | 0.5 | 0.5 | 1 |
| Loss | 3.5 | 13% | 2.5% |

Number 1 refers to a gasoline recovered by a charcoal plant situated right on the field; No. 2 refers to a gasoline likewise recovered from field gases but the plant was situated at a long distance from the fields and, as the day when the sample was taken was a very cold day, large amounts of "drip" gasoline were formed on the line by simple condensation and hence the gasoline recovered in the plant was very light and had an endpoint of only 103 degrees C. The third sample is that of a typical gasoline recovered from refinery uncondensed still vapours (No. 3).

Some calculations of the operating expenses of activated charcoal plants might be of interest. The direct expenses in such plants are proportional to the quantity of recovered gasoline and therefore they can be best indicated per ton or gallon of recovered gasoline. These direct operating expenses are limited to the following three items: steam, water and charcoal.

The steam requirements vary between three and 4½ tons per ton of recovered gasoline. This figure is under the as-

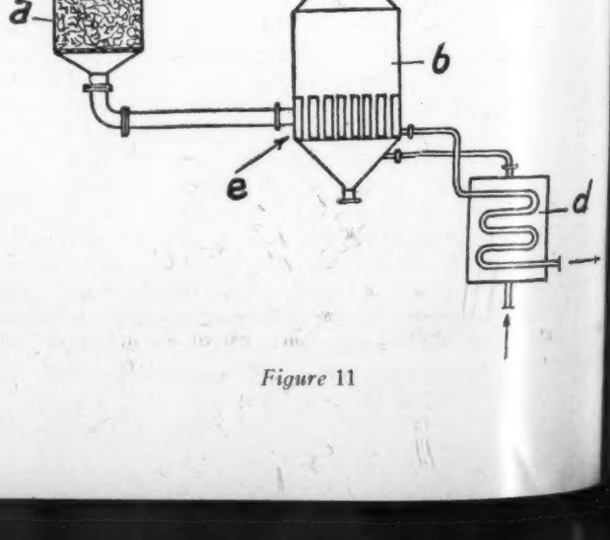



*Figure* 11

sumption that steam drive is used for the air exhauster. The steam consumed in the process itself is really only two to 3½ tons per ton of recovered gasoline.

The water consumption is very low and is practically limited to the water evaporated in the cooling tower or cooling pond. As a matter of fact these evaporation losses of the water are compensated by the condensate of steam which is added to the water circuit, and there are cases of many plants having been operated even during the summer months with no supply of fresh water.

The consumption of charcoal in the recovery of gasoline from field gases, free of sulphur compounds, is limited to a mechanical loss, which does not exceed one kilogram of charcoal per ton of recovered gasoline.

Where the gas contains sulphur compounds—and this applies especially to still vapours in certain refineries — such sulphur compounds are prevented to some extent from influencing the activity of the charcoal by filtering the gas

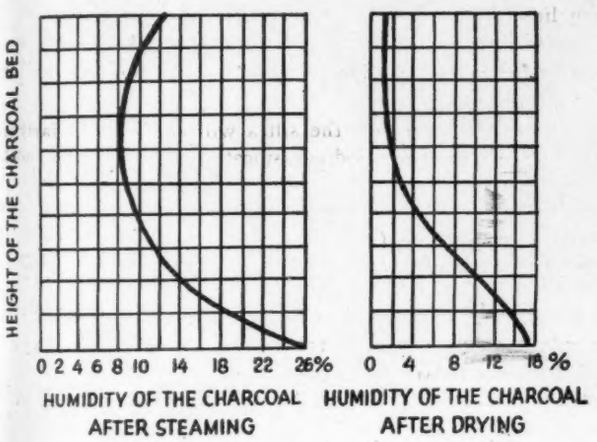

HEIGHT OF THE CHARCOAL BED
0 2 4 6 8 10 14 18 22 26%
HUMIDITY OF THE CHARCOAL AFTER STEAMING
0 4 8 12 16%
HUMIDITY OF THE CHARCOAL AFTER DRYING
HEIGHT OF THE CHARCOAL BED
0 2 4 6 8 10%
HUMIDITY OF THE CHARCOAL AFTER COOLING
0 2 4 6%
HUMIDITY OF THE CHARCOAL AFTER ADSORPTION

*Figure* 13

through scrubbers containing a lower brand of activated charcoal. Furthermore, unsaturated hydrocarbons in presence of activated charcoal polymerize and fill the capillaries with some sort of asphaltic material which likewise reduces the adsorption capacity. In such cases, some three kilograms of charcoal have to be replaced per ton of recovered gasoline but only half of the expense should be reckoned with because the other half is reclaimed by either re-activating the charcoal in the works or using it as a filtering agent. In some rare cases where, for the above mentioned reasons, the quality of the gas is not suitable, the application of the process should be avoided before the methods of scrubbing the gas had not been further improved.

The direct operating expenses, consisting of the above mentioned three items, are calculated per ton and per gallon of recovered gasoline in the following statement:

(a) *Steam*—Consumption 3-4½ tons per ton of gasoline; cost of steam 4½ shillings per ton; cost of steam per ton of gasoline production ..... £ 0. 13.6 to £ 1. 0.3

(b) *Water*—Consumption none to six cbm. per ton of gasoline; cost of water six pence per cbm; cost of water per ton of gasoline production ..... £ 0. 0.0 to £ 0. 3.0

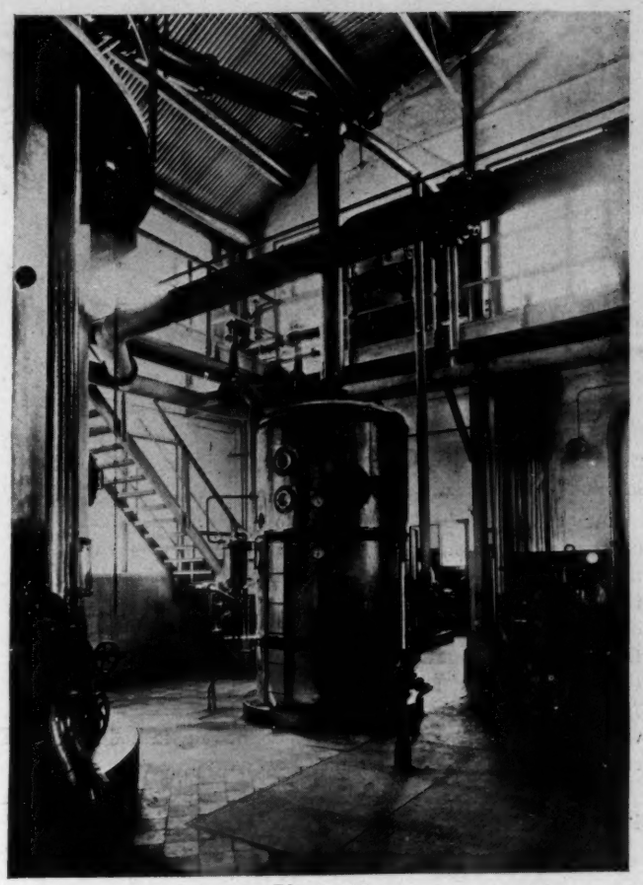


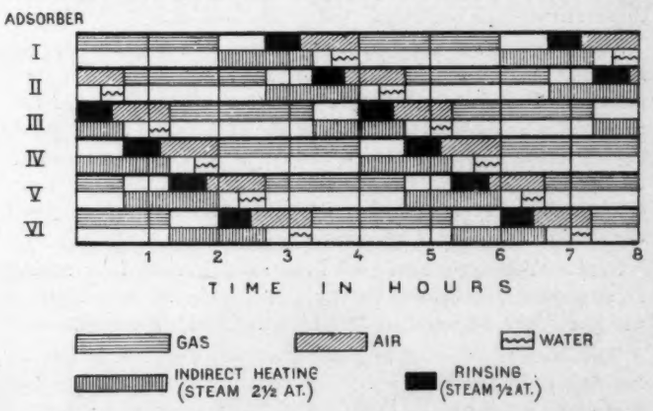
*Figure* 12

(c) *Activated Charcoal* (mechanical loss) — Consumption one-half to one kgr. per ton of gasoline; cost of activated charcoal $1 (£ 0. 4.2) per kilogram; cost of activated charcoal per ton of gasoline production ..... £ 0. 2.1 to £ 0. 4.2

Total cost per one ton of gasoline £ 0. 15.7 to £ 1. 7.5

total cost per imperial gallon .....0. 5½ to 1d.

In such cases where the charcoal has to sustain, besides the above-stated insignificant mechanical loss, some loss of its




EXAMPLE OF SCHEDULE OF OPERATION IN A PLANT WITH 6 ADSORBERS (OF GREAT HEIGHT), WORKING ON LEAN GAS: 4 HOUR CYCLE

*Figure* 14

activity, an extra expense of about six shillings per ton of recovered gasoline should be taken into account for charcoal renewal

If the items for amortization, labor and general expenses are included, the above figures should be practicaliy doubled, but this does not preclude gasoline recovery, whether from field gases or from refinery still vapours, from being in most cases a wise and profitable operation.

# Prevention of Corrosion Under Water*

By R. A. BOYD
*Assistant Superintendent Columbian Gasoline Corporation*

THE rust formed under water is soft, whereas the rust formed in the atmosphere is usually very dense and hard. Composition of iron or steel has very little effect on corrosion under water. Oxygen concentration, temperature, velocity of motion, dissimilar metals or solutions, in contact, are some of the controlling factors.

One of the most notable and expensive examples of corrosion of dissimilar metals in contact was the Yacht Sea Gull, which was built with monel metal plates, with the exception of the stem, keel and rudder, which were ordinary steel, and some iron rivets were used. On the first trip this yacht sprung leaks due to failure of some of the iron rivets and when put in dry dock it was found that the steel parts were so badly corroded that the vessel was junked The monel metal acted as a cathode and the corrosion was localized on the steel parts.

Metal under water may be protected by artificial coatings.

Coatings formed by the action of corrosion itself, and water treatments such as the addition of alkalies and by the removal of oxygen and other corrosive agents.

The surface of a metal to be coated with any kind of paints should always be absolutely clean and dry before the coatings are applied.

Paints are not very satisfactory under water.

Red lead in boiled linseed oil or red oxide of iron have been found by experience to give the best protection for the longest period.

These coats of lead have been found to give protection for a period of five years in Boston, Mass., on standpipes, these standpipes being painted inside and out.

Zinc applied by the hot dip process is very effective in stopping corrosion in some waters where acids are not present. Rosedale cement, is one of the best coatings for protection under water and inside of pipes. It is quick drying cement, this mixture should be one part cement to one part of sand. Pipe protected in this manner has been known to be in service for 20 years and still be in good condition.

Special mandrels made of brass and having four spring steel guides are drawn through smll pipe to coat them, a coating from 1-8 inch to 3-16 inch thick is usually used.

The New York Catskill Aqueduct was protected on the inside with a one to two sand portland cement mixture two inches in thickness. Portland cement over steel with a coating of sulphur is used as a protection against chemicals.

### Hot Water Systems

Many samples of rust from the inside of water pipes which have given long service show large amounts of calcium carbonate and silica.

In the Great Lakes region and in some other localities calcium carbonate and silica form so rapidly on the inside of pipes, especially where the water is heated, that it practically closed up the pipe.

Treatment with sodium silicates are very effective in closed water systems. The addition of sodium silicate to cold water will reduce the corrosion 50 per cent. and to hot water about 80 per cent. This is due to the difference in oxygen concentration. However, in hot water systems with lines over 200 feet long at the point where the silica is introduced there will be a good coating formed, at a greater distance than 200 feet there is hardly any coating at all.

In cold water systems the silica will carry much farther. For cold water liquid sodium silicate is best to use, while with hot water the solid silica is easily dissolved. When a sodium silicate treatment is started the amount of silicate added is usually from 15 to 30 parts per million until a good coat is formed and then it is reduced to from five to ten parts per million.

Where the water is circulated in the air over pipe coils it is out of the question to remove the dissolved oxygen but, by the addition of sodium silicate on lime to the water corrosion can be greatly retarded. An application of 20 parts per million of sodium silicate or 15.6 pounds to 1000 cubic feet of water will almost completely stop the action of water on iron.

In brine tanks the corrosiion can be retarded by making the water alkaline. Sodium silicate in brine solutions does not do enough good to warrant its use.

### Cooling Systems

Most of the corrosion in refrigeration systems is found at points which are alternately wet and dry, for this reason the level of the brine tanks should be kept as nearly as possible at the same level.

The alkalinity of a brine solution can be maintained by the addition of milk of lime, or by suspending a sack of flaked caustic soda in the solution. If this is done, however, the brine should be tested every week by titration with hydrochloric acid. Or phenolphthalein indicator can be used to test for alkalinity and should be maintained at the point where the indicator reaches its maximum red color. The alkalinity can be automatically maintained by circulating the brine over a sufficient quantity of zinc which forms zinc hydroxide. This also helps to remove the dissolved oxygen from the brine solution.

Dissimilar metals in contact should be avoided as much as possible in brine systems. In closed water systems the amount of dissolved oxygen present is the controlling factor of corrosion and is limited. If this dissolved oxygen is removed corrosion is practically eliminted.

For this reason the removal of dissolved oxygen and gases has been given quite a bit of thought by engineers in recent years, as this one factor alone prolongs the life of boilers, closed water systems and similar systems. Complete removal of oxygen has been accomplished economically in boiler plants using 2,400,000 pounds of water per hour.

As a usual thing in closed water systems of any length

*Continued on page 92*

*Paper read before foremen's meeting of the Columbian Gasoline Corporation.

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# Methods of Testing Gasoline for Anti-Knock Properties

The following data relative to the various methods of testing gasoline for anti-knock properties now being used in the United States were arranged and compiled by H. G. Koehler of the Research Laboratories of the Universal Oil Products Company and were given in the Library Bulletin of that company, Volume 2, No. 21, pps. 160-161.

| Outline of Laboratories and Principal Factors Controlling Engine Tests | Armour Test Roesch | Atlantic Ref. Co., Hill | Ethyl Gasoline Corp. Edgar | Gen. Motors Corp. Boyd | S. O. Ind. Wilson | S. O. N. J. Howard | Universal Oil Prod. Faragher | University of Michigan Brown | Bur. of Standards Dickinson |
|---|---|---|---|---|---|---|---|---|---|
| Engine Type | 4 Cyl. Hupmobile | Single Cyl. Lockwood Ash | Delco | Single Cyl. Var. Comp. | Single Cyl. L-Ash | Delco | Delco | Single Cyl. Marine | Single Cyl. Liberty |
| Cooling System | Water | Water Externally Oper. | Water | Water | Water | Water | Water | Water | Water |
| Load Control | Sprague Dyn. | Hand Oper. | Rheostat | Sprague Dyn. | Prony Brake | Mech. Brake | Rheostat | Dyn. | Sprague Dyn. |
| Compression Ratio | 4.58-1 | 6.5-1 | 6.4-1 | Constant During Test | 6.5-1 | ..... | 5.8-1 | 7.3-1 | 7.2-1 |
| Methods of Comparison | Listening Mean Brake Effective Press | Benzol Blds. | Bouncing Pin Tetra-ethyl | Bouncing Pin Listening | Benzol Bl. | Bouncing Pin Road Tests | Mod. Bouncing Pin Benzol Bld. | Torque Benzol Bl. | Listening Max. Power Without Det. |
| Preheated Air Temp. | Constant | 140°F. | | Constant | 140°F. | | 120°F. | 113°F. | Constant |
| Water Outlet Temp. | Constant | 155°F. | 180° F. | 180°-200°F. | 155°F. | | 170°-180°F. | 176°F. | Constant |
| Spark Position | Advancing From Top D. C. | Constant 25° Adv. | | To Make Aud. Knock | Constant | | Constant During Test | Adv. to get Max. Torque | 30° Adv. |
| Motor Speed R.P.M. | 1000 | 1200 | 1000 | 850 | 1200 | 1000 | 1350 | 1500 | 1500 |
| Air-Fuel Ratio | To Give Max. Power | 12.5-1 | 12.0-1 | | 11.0-1 | 13.5-1 | Constant | To Give Max. Power | Full Rich to Full Lean |
| Throttle | Full | Adj. to 1st Aud. Knock | | | Adj. for Max. Power | Wide Open | Fixed | Constant | |

| Outline of Laboratories and Principal Factors Controlling Engine Tests | Tide Water Oil Co. Parsons | Sun Oil Co. Clayden | Gulf Refining Co. Smith | Kansas City Laboratory Cross | Asiatic Pet. Co. Ricardo | British Air Ministry King, Sims, Mardles | Ohio State University Charch | Univ. of Iowa, Olin, Read, Goos |
|---|---|---|---|---|---|---|---|---|
| Engine Type | Delco | Single Cyl. Regal Marine | Delco | Single Cyl. Novo. Var. Comp. | Var. Comp. | Var. Comp. | | 2-Cyl. Motorcycle |
| Cooling System | Water | Water | Water | Water | Water | Water | | Air |
| Load Control | ..... | | Grids | Lamp-Bank | | | | Water-Cooled Prony Brake |
| Compression Ratio | ..... | 5.5-1 | 5.8-1 | Var. | 2.7-1 7.9-1 | | | |
| Methods of Comparison | Bouncing Pin Benzol No Road Tests | Bouncing Pin Road Tests | Bouncing Pin Tetraethyl Benzol Bld. | Max. Brake H. P. Benzol Equiv. | Comp. Ratio at 1st Aud. Detonation | H. J. C. R. | Electrical Conductivity Bouncing Pin | Brake Mean Effective Pressure |
| Preheated Air Temp. | | | | 74-76° F. | | | | |
| Water Outlet Temp. | | | 170°-180°F. | 140°F. | | 140°F. | | |
| Spark Position | | Fixed | To Give Max. Power | 30° Adv. | | 30°F. Adv. | | Constant |
| Motor Speed R.P.M. | | 450 | 950-1000 | 500 | | 1500 | | 1400 |
| Air-Fuel Ratio | | | To Give Max. Power | | | | | |
| Throttle | | | Constant | | | Full | | |

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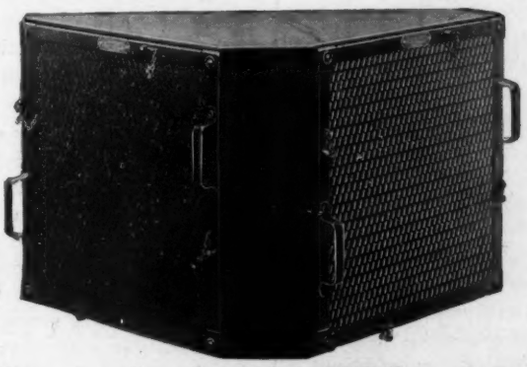
2. Low resistance to air flow, resulting from thin wire-strand baffling, which permits air to flow in an almost straight line.

3. Large dust accumulating capacity is afforded because dust is evenly distributed, and each strand of wire functions continually; additional oil being supplied by capillary attraction as fast as original charge is absorbed by dust.

4. Reed filters require less frequent cleaning because of large capacity per unit, reducing maintenance to a minimum. Filter cells are easily and quickly removed by loosening four wedge fasteners, and weigh only 20 pounds each.



As an example of the widespread use of Reed Filters by leading Oil Companies, we refer to the illustration above which shows 5 three unit Type SCF Reed Filters with weather louvres which are furnishing CLEAN air to compressors. Write for illustrated catalog which describes in detail how Reed Air Filters can lower your compressor and engine operating costs.

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# Industrial Accidents Can Be Prevented

By C. W. PRICE
*Director, Training Course for Safety Engineers, New York University*

IN the 20 years' history of accident prevention in the United States three facts stand out:

1. The experience of hundreds of industrial plants has demonstrated absolutely that 75 per cent. of all disabling accidents can be eliminated in any industrial plant.

2. In any company in which efficient safety work has been done it has paid, not only ordinary dividends, but extraordinary dividends; it has, therefore, been permanently incorporated as a necessary part of plant efficiency in thousands of companies.

3. Not more than 15 per cent. of the disabling accidents in the average factory can now be eliminated by mechanical guards or safety equipment. Eighty-five per cent. of the preventable accidents must be prevented through organized educational effort that gets the men sincerely interested in protecting themselves and their fellow workers and keeps them interested.

Methods of accident prevention have become standardized and they may be applied, with differences only in detail, to the solution of the accident problem of nearly all industrial organizations. Some hazards are peculiar to certain industries, but most serious hazards, such as material handling, obstructions which may cause falls, unguarded moving parts, and flying particles which may injure the eyes, are common to all. The methods of accident prevention outlined in these articles have been applied successfully to plants in every industry where there is an accident problem. Their effectiveness may be judged from a brief summary of results in a few cases.

The first organized effort for the prevention of accidents in industry was made in the plants of the United States Steel Corporation in 1907. This company affords an excellent example of what can be accomplished through safety work since it includes in its numerous branches nearly every type of hazard to be found in industry. Despite the size of the steel corporation, the results of its safety work are representative of the accomplishments of all types of industrial concerns, small and large.

Twenty years of safety work by this corporation has saved 368,000 men from accident. If a campaign of accident prevention had not been undertaken, and accidents had continued at the same rate as in 1906, 46,000 of these men would have been killed or seriously injured, and the rest injured sufficiently to cause considerable loss of time from work. Comparison of the figures of 1925 with those of 1906 shows that the United States Steel Corporation has reduced disabling accidents 84 per cent., and the corporation has made a net saving of $1,000,000 a year through its safety work.

The steel corporation did one thing with excellent results which might be adopted to advantage by any organization. This was the inauguration by the late Judge Gary, several years ago, of the Gold Star Honor Roll Contest. The rules of the contest provided that if, during 30 days, no man of a plant was sufficiently injured to cause him to lose time after the day of injury, that plant was placed on the Gold Star Honor Roll, which was to be printed and posted in every plant. A spirited competition among the managers ensued.

In 1926 the corporation had 306 plants, with 250,000 workmen employed in what was originally one of the most hazardous of industries. In each month of that year, in an average of 175 plants, there were no accidents resulting in loss of time. The 2800 employes of the Joliet plant of the Illinois Steel Company recently established a record by operating for four months without one accident causing the loss of time of a single workman.

Another striking example of what can be accomplished in an industry which has an extensive material handling problem with all its attendant accident hazards is afforded by a large steamship company employing 700 men for loading and unloading vessels. Because of the character of the labor employed and the nature of the work, the accident situation among stevedores is considered one of the most difficult to control. Before March 1, 1926, when the safety campaign was started in this company, accidents had been so frequent that they resulted in an average loss of time of about 200 hours for every 1000 hours of work. In July, after four months of safety work, lost time had been reduced to 80 hours for every 1000 hours of work.

Despite the excellent records being made in the reduction of industrial accidents, there is still a vast amount of safety work to be done, especially in the smaller plants. Industrial accidents in the United States are increasing every year. Between 1919 and 1923, the number of accidents causing loss of time increased 27 per cent. The rate of increase from 1923 to the present time is in many States even greater. In 1925, 23,000 men and women were killed by accidents in industry in the United States, and 575,000 more were seriously injured. Millions of others received injuries grave enough to cause them to lose a day or more of time. A total of 300,000,000 days are lost through accidents each year. This is equivalent in wages to more than one billion dollars. But the loss to industry was far greater than this.

The chief engineer of one of the large insurance companies has estimated that only one-fourth of the actual cost of an accident can be insured. Insurance covers only the liability of the employer for compensation to the injured employe or to his family, while the total cost, he believes, is four times as great. A typical case in which the compensation cost was only a small percentage of the total cost occurred recently. A man was killed, and everyone stopped work to see what had happened. So great was the demoralization that for two days following, only a few men were able to keep up with their regular schedule, and not until a week after the accident was operation back to normal. This example is not extreme; even in a well organized machine shop, everyone stops work when a bad accident occurs, and there is an additional loss when a new man, unfamiliar with a machine, cannot make it produce as much as the man who was injured.

The experience of hundreds of plants has demonstrated that 75 per cent. of all accidents in industry can be prevented. This would mean the saving each year of 17,000 lives, the prevention of serious injury to 430,000, and the saving of three-quarters of a billion dollars by employers—certainly a goal worth striving for.

# Western Petroleum Refiners Meet at Shreveport

SHREVEPORT, LA.—Fifty refinery superintendents, chemists and engineers were in attendance at the two-day meeting of the manufacturing group of the Western Petroleum Refiners Association here, June 4 and 5, and in addition to the reading and discussion of a group of papers on various engineering subjects, the visitors were shown through the plants of the Shreveport refining center.

L. R. Crawford, vice-president of the Producers & Refiners Corporation, of Independence, Kansas, and chairman of the manufacturers committee of the association, acted as chairman of the Shreveport meeting. At the first session, and upon the completion of presentation of L. D. Mann's paper on refinery losses, Mr. Crawford led the discussion and predicted that the time was not far distant when vapor pressure would be among the specifications of refinery gasoline. Mr. Mann, who is assistant general superintendent for Empire Oil & Refining Company presented the thought that refinery gasoline holds in solution light gases which tend to escape with raising of temperatures and contribute to tank car outages. He stated that lower boiling point range motor fuels and anti-knock quality is forcing the refiner to more exacting methods of handling these products and eventually the time will come when refiners will handle their products in all gas tight equipment. Mr. Mann discussed refinery losses in detail in all of the refinery departments.

K. J. Smith, superintendent of Skelly Oil Company's refinery, stated that he plans the segregation of his gasoline made in the recovery plant from that of the refinery proper, in order to reduce the amount of gases being recirculated through his recovery plant and lower any losses that may occur due to release of very light vapors in solution in the finished gasoline. F. E. Wellman, Manhattan Oil Company, Kansas City, told of cutting loading losses from 80 gallons per tank car loaded to 10 gallons, by extending the loading line to the bottom of the car and covering the open dome, while loading, with wet sacking placed around the loading line.

Prof. T. McLean Jasper's paper on "Design of Pressure Vessels for the Petroleum Industry" was of much interest to the technical men and evoked spirited discussion after its presentation. Prof. Jasper illustrated his lecture with lantern slides, and gave detailed information relative to the experiments made for the determination and selection of the proper metals for use in the manufacture of pressure equipment.

Don J. Wallace, safety director of the Mid-Continent Oil & Gas Association, presented a paper emphasizing the need of co-operation from the supervisory force in the work of making safety pay the dividends that it should.

L. M. Johnston and J. L. Farrell, of Producers & Refiners Corporation, literally took their refinery to pieces and rebuilt it in their paper, showing how the careful installation and design of auxiliary equipment effected a saving of $80,000 annually in their power plant. Their paper marks one of the few times in convention history where engineers were permitted to discuss not only costs, but comparative costs, and because of this fact the paper is greatly enhanced in value.

Papers by L. S. Cannon, Marland Refining Company, and W. R. Hounsell, Houston Oil Company, concluded the program. Mr. Cannon discussed the importance, service and efficiency of the laboratory in refinery operations. His paper gives in general the main control points and methods of control for refinery operations, and convincingly indicates that scientific control of the refinery processes and operation is essential and profitable.

W. R. Hounsell, in his paper, "Treating Cracked Distillate with Acid in Continuous Operation," presented some interesting points for consideration. In the matter of the type or strength of acid which serves best in chemical treatment of the pressure distillate, he said, "We know that 66 Baume sulphuric acid is going to give us high losses due to sulphonation and polymerization of portions of the distillate that we do not want affected by the acid. The works of many well known men, and a little experience of our own, indicate that the best acid strength to use for this purpose is from 62 to 64 Baume, or as near 84 per cent. $H_2SO_4$ as convenient. This strength of acid will react with the di-olefins and sulphur compounds fairly rapidly; it does not react with the aromatics noticeably, and reduces possible reaction with the olefins to the minimum. Fortunately, also, this strength acid does not attack iron or steel, and it is not so difficult to produce from reclamation of acid-sludge when using a modern recovery process."

Local refiners were the hosts to those visiting the city for the two-day meeting. The afternoon time on both days was spent in visiting the refineries of the Crystal Oil Refining Corporation, the Louisiana Oil Refining Corporation, and the Shreveport Producing and Refining Company. Crystal Oil Refining Corporation entertained the visiting refiners at luncheon Monday.

# California Association

Los Angeles.—At the annual meeting of the California Natural Gasoline Association, held June 14 at the Alexandria Hotel, new officers and 10 directors were elected for the ensuing year. George L. Ratcliffe of the General Petroleum Corporation was re-elected president and H. L. Eggleston of the Pan American Petroleum Company was re-elected vice-president. H. L. Parmelee of the California Gasoline Company was elected secretary and treasurer by the executive committee.

The 10 directors elected were C. E. Beesemyer, Gilmore Gasoline Company; Louis V. Cassaday, Lomita Gasoline Company; J. L. Denny, California Eastern Oil Company; O. C. Field, O. C. Field Gasoline Corporation; R. W. Garman, Union Oil Company; R. H. Green, Signal Gasoline Corporation, Inc.; Ben A. Kohler, George F. Getty, Inc.; E. H. Pratt, Honolulu Consolidated Oil Company; F. N. Rumbley, Lovell Gasoline Corporation, and J. F. Vordermark, Torrance Gasoline and Refining Company.

C. E. Beesemyer, Louis V. Cassaday and R. H. Green are new members of the board of directors, while the remainder elected were members of the old board.

Directors met June 21 and elected the following executive committee: R. E. Beckley, R. W. Garman, O. C. Fields, J. S. Watson, J. N. Hicks, J. R. Linhoff and H. L. Parmelee. G. L. Ratcliffe and H. L. Eggleston are members of the committee by virtue of office.

The report read at the annual meeting by Paul D. Barton, retiring secretary and treasurer, showed a membership of 496, of which 308 were new members.

Members of the association who attended the annual meeting of the Natural Gasoline Association of America, held at Tulsa, May 22-23, discussed the various papers read before the national organization.

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# Proper Raw Materials Essential to Successful Grease Making

By H. L. KAUFFMAN

THE raw materials that enter into the manufacture of true greases of the soap type may be classed under four main headings, as follows:

1. Fats and fatty oils.
2. Alkalies or bases.
3. Mineral oils; rosin and rosin oils.
4. Chemicals and special raw materials; e. g., oil of myrbane, which frequently is used to give cup greases an odor; oil-soluble dyes, which are used by some grease-makers to color cup and railroad-engine greases; fillers, such as graphite, talc, cork, mica, etc., which are used in the manufacture of greases of a special type.

In well-made greases, no great quantities of either fatty oil or alkali are present in the grease as such (unless their presence in the free state is to give the grease a definite quality), and in most cases these two raw materials are combined chemically to form soap. The soap, in turn, serves to thicken the mineral oil, which latter, however, is not changed essentially in the process of manufacture. Those materials mentioned above under the fourth heading likewise are not changed during the process, but continue to exist in the grease uncombined with any of the other components.

### Fats and Fatty Oils

Upon the choice of the fat or fatty oil, from which the soap is made, depends to a large extent the appearance and the quality of the finished grease. It is therefore very impotrant for the grease-maker to know the kind and quality of fatty oil that is required in orde rto produce a grease of the desired appearance and characteristics.

It is true that fats and fatty oils from many different sources have nearly the same composition, for all are composed of varying proportions of certain fatty acids in combination with glycerol. For example, horse oil, which is used facture of cup greases, is much the samea s beef tallow, with the exception that, in the former, a larger percentby many grease-makers in the manuage of oleic acid and a smaller percentage of stearic acid are combined with glycerol than in the latter. Since oleic acid is one of those acids that has a tendency to oxidize and to stiffen, horse oil has more of these characteristics than does pure beef tallow. It is worth noting, also, that many other acids occur in varying amounts in different fats—these acids giving to the fats or fatty oils their distinctive odor, color or appearance. However, mosto f these acids have little effect on the characteristics of the greases genearlly made.

### Alkalies or Bases

Most manufacturers use only the hydroxides of sodium, potassium and calcium in their grease-making. The choice of the alkali is dependent on the chaarcteristics required in the finished grease. The soap formed from each of these different alkalies has its own individual characteristics.

Aluminum sulfate and lead oxide are other chemicals that are also used occasionally in grease-making. The former is used in making aluminum soap, which is the main component of castor machine oil; the latter is used in making lead soap, which is present in car oi alnd in certain types of gear lubricants.

### Sodium Hydroxide

Sodium hydroxide is also known as caustic soda, or common lye. It is produced mainly by the electrolytic process from common salt, although several older processes dependent on certain simple chemical reactionsa re still in operation. Electrolytic caustic soda is made by passing an electric current through a solution of common salt, whereby the satl is separated into its constituents, and a solution of caustic soda is made. This lye solution is then concentrated by boiling until it solidifies.

Both flake and lump caustic soda are used by grease-makers. In nearly all cases, the product is bought on a specification as to its sodium-oxide content. The grade of caustic soda usually bought for grease-making contains 76.0 per cent of sodium oxide ($Na^30$), and this is the percentage commonly specified. This material should be of a high degree of purity and be entirely free from gritty or other foreign matter.

### Calcium Oxide and Calcium Hydrate

Few manufacturers of grease buy lime on fixed specifications. Most of them rely on the personal word of the grease-maker as to the kind and grade of lime that in the past has given thorough satisfaction, and that could be expected to prove satisfactory again, if obtained from the same source.

That there is need for definite specifications in the purchase of lime for grease-making is a well-known fact. Those manufacturers who buy lime on fixed specifications, and carefully test the purchased material, can be assured of a greater uniformity in the quality of their finished product. However, in some instances, the specifications should be more complete, as is shown by the fact that one manufacturer has as his only specification that the quick-lime shall contain at least 90 per cent of available calcium oxide.

Another purchaser of quick-lime for use in grease-making specifies a minimum calcium oxide content of 96 per cent; a maximum silica, and iron and aluminum oxide content of 1.0 per cent; a maximum carbon dioxide content of 1.1 per cent; and not more than a trace of any other foreign materials.

Still another grease-maker, who uses hydrated lime exclusively for both cup and axle grease manufacture, buys it on the following specification as to chemical composition, calculated to a non-volatile basis:

| | Per Cent |
|---|---|
| Calcium oxide, minimum | 96.0 |
| Magnesium oxide, maximum | 1.2 |
| Silica, maximum | 0.8 |
| Iron and aluminum oxides, max. | 0.6 |
| Carbon dioxide, maximum | 1.2 |

It is essential that the lime used in grease-making should have a high calcium oxide content, and a low content of all other constituents. It is necessary to have a lime low in silica, iron and aluminum oxides, and unburned calcium carbonate since such impurities, if present in such fine form that they are not caught in screening, would appear in the finished product and in use would have an abrasive effect on the bearings. It is also necessary that the lime shall enter into the chemical reactions with rapidity.

A grease is just as good as the raw materials from which it is made. Axle greases are made for rough lubrication; therefore, a lower grade of lime probably could be used satisfactorily. However, few, if any grease-makers buy different grades of lime to serve different purposes.

With these points in mind, and based on the writer's personal observations and experience, it is his opinion that the following specifications should be used in buying hydrated (slaked) lime for use in grease-making.

1. The lime shall be a very high calcium lime and shall be of such texture and of such fineness that all portions of it will come readily into intimate contact with fixed or resin oils, so as

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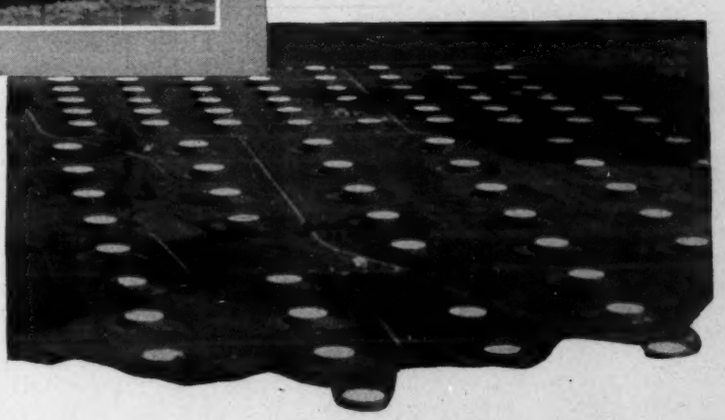

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to enter into the chemical reactions with rapidity.

2. The lime shall be completely hydrated, since a high degree of hydration is necessary.

3. Not more than 10 per cent of the hydrated lime shall be retained on a No. 250 screen.

4. The hydrated lime shall conform to the following requirements as to chemical composition, calculated to a non-volatile basis:

| | Per Cent |
|---|---|
| Calcium oxide, minimum | 96.0 |
| Magnesium oxide, maximum | 1.0 |
| Silica, and iron and aluminum oxides, maximum | 1.5 |
| Carbon dioxide maximum (if sample is taken at other than place of manufacture) | 3.0 |

It is the writer's opinion that the above requirements as to the chemical composition of hydrated lime, calculated to a non-volatile basis, should also be used as specifications in buying quick-lime for grease-making. In addition, it would be advisable to specify that the lime shall be fresh and substantially free from ash, dirt and core, and that it shall be very reactive chemically. A quick-slaking lime is always desired.

One large manufacturer, for making all of his greases, uses exclusively calcium hydrate, which is a pure form of what is ordinarily known as slaked lime. A very pure grade of limestone is used as the source of this material. After quarrying, the limestone is crushed to a coarse lump size, after which it is burned in a modern, rotary lime-kiln. The burned lime is hand-picked to secure only the highest quality material. This material is then run through a slaking machine, which very accurately proportions the quantity of water necessary for the complete slaking of the quicklime. The resultant product is a very fine, perfectly dry powder of the grade known as "chemical lime." Impure limestone will not slake to a fine powder. In some cases, even greater purification of this product is obtained by screening through a 200-mesh sieve. An advantage claimed for the use of dry, slaked lime is that this material retains its characteristics much better than does quicklime, and that, therefore, it is in better condition to stand long shipments and storage for longer periods of time.

### Mineral Oils

Because of the large variety of mineral oils employed in the manufacture of greases, it is almost impossible to list all the different grades of oils used, and hence no attempt will be made to do this. In any case, laboratory tests on the oil that is used should be made regularly, in order to maintain a uniform finished product.

In the past, the manufacture of well-made greases of uniform quality has been largely an art, but in recent years careful laboratory control of the raw materials used in the process, together with frequent tests on both the unfinished and finished product, is causing grease-making to be both an art and a science. Greatest developments are made in this industry when there exists full cooperation between the skilled grease-maker and the chemist. The former possesses invaluable practical experience that aids in maintaining the uniformity of all batches of grease. The latter aids in this work by selecting, testing, and keeping uniform the raw materials that enter into grease-making; by checking the uniformity of the product both during the process of manufacture and after it has been drawn into shipping containers; and, finally, by constant research and experimental work in developing new products to meet particular lubricating conditions, or by noting wherein improvements can be made in existing methods of operation. Upon the chemist also falls the responsibility of handling any complaints on the product. It is then his duty to take the necessary steps to correct the processing operation for that particular type of grease, if the complaint has been due to the quality of the product; or to make recommendations for a type of grease that would be suitable for the work to be done, if an analysis of the complaint showed that a type of grease had been used that was not a suitable lubricant for the particular place in which it had been used, and that a different type of grease would be satisfactory.

If the interested reader will indicate by communication with the writer at 610 Midland Savings Building, Denver, Colorado, the particular phase of grease-making and manufacture of related products in which he is particularly interested or concerning which additional information relative to manufacturing or marketing of that product is desired, the writer will be pleased to reply to him either personally or to make the subject matter of his inquiry the basis of a special article, which then would appear in the pages of this journal at an early date.

### Potassium Hydroxide

Potassium hydroxide, or caustic potash, or potash lye, is made in a similar manner to sodium hydroxide, with the exception that the raw material, of course, must be a potash salt. Only small quantities of potassium hydroxide are used in grease-making, as it produces a very soft soap of low melting point. Its use is advantageous, for the most part, only in cases where emulsification with water is a property to be desired in the grease.

# Zuderhoudt Process of Low Temperature Carbonization

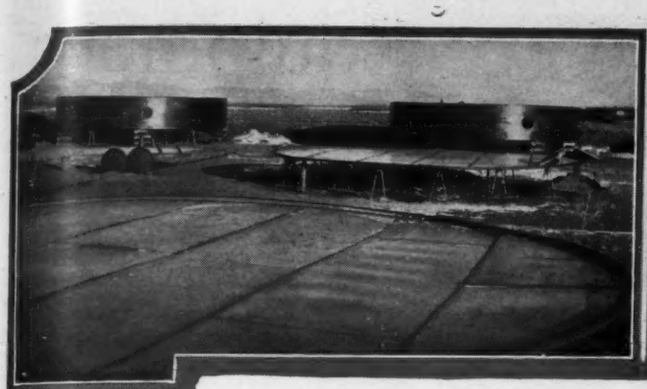
As an indication of the further interest of European scientists in the commercial possibilities of manufacture of motor fuels through the conversion of coal into liquid hydrocarbons, the following excerpt from Fernand Lambermonth, Brussels, Belgium, in his January letter to Industrial and Engineering Chemistry, news edition, is presented:—

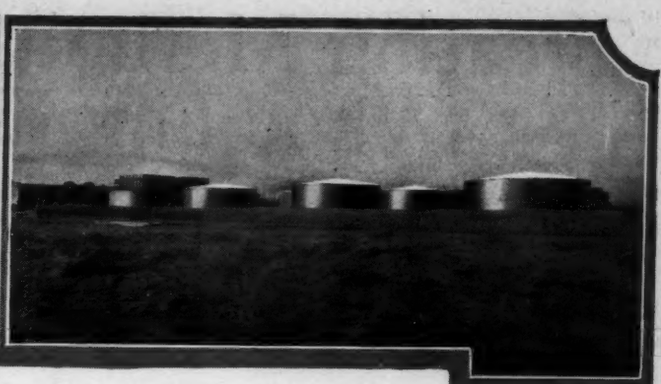
"It is apparent that for our European countries, generally rich in solid fuels but poor in petroleums, the distillation of coal at low temperatures can contribute appreciably to the production of liquid hydrocarbons. During the congress mention was made of a new process of treating fuels at low temperatures—the Zuyderhoudt process. This process, worked out for several months in Belgium, is still little known. It will therefore be described here in a few words.

"This process tends to unite the principles of recuperation and progressivity. The inventor found his inspiration in the tunnel and Hoffman ovens used in many industries, which are based on these principles. The essential feature consists in application of the ring oven to carbonization at low temperature by external heating. The Zuyderhoudt installation includes a series of intercommunicating chambers, each containing thirty-two vertical retorts. These retorts, which are made of soft steel, have a capacity of about 25 kilograms of fuel. Each one is crossed at its axis by a cylindrical steel tube of two inches diameter, pierced with holes throughout its length. The gas from the distillation passes through these holes without coming in contact with the often superheated external walls of the retort, thus escaping the effects of cracking. On opening the retorts, the gases coming from the same battery unite in a collector, from which they are removed upon condensation.

"The oven is operated in the following manner: One chamber is heated directly, its burners being controlled so that the temperature of the end of carbonization (450 degrees to 500 degrees C.) may be maintained in the retorts while heating. The burned gases then pass successively into other chambers in which they progressively heat the retorts (as in the Hoffman furnace) and finally escape through the chimney. At the end of the carbonization this chamber is cooled while another one is being heated, the first air being heated by its passage through the chamber which is being cooled. This manner of operation presents a double advantage: (1) The coal is heated progressively in the retorts, avoiding the excessive swelling of the coal in

(Continued on page 92)





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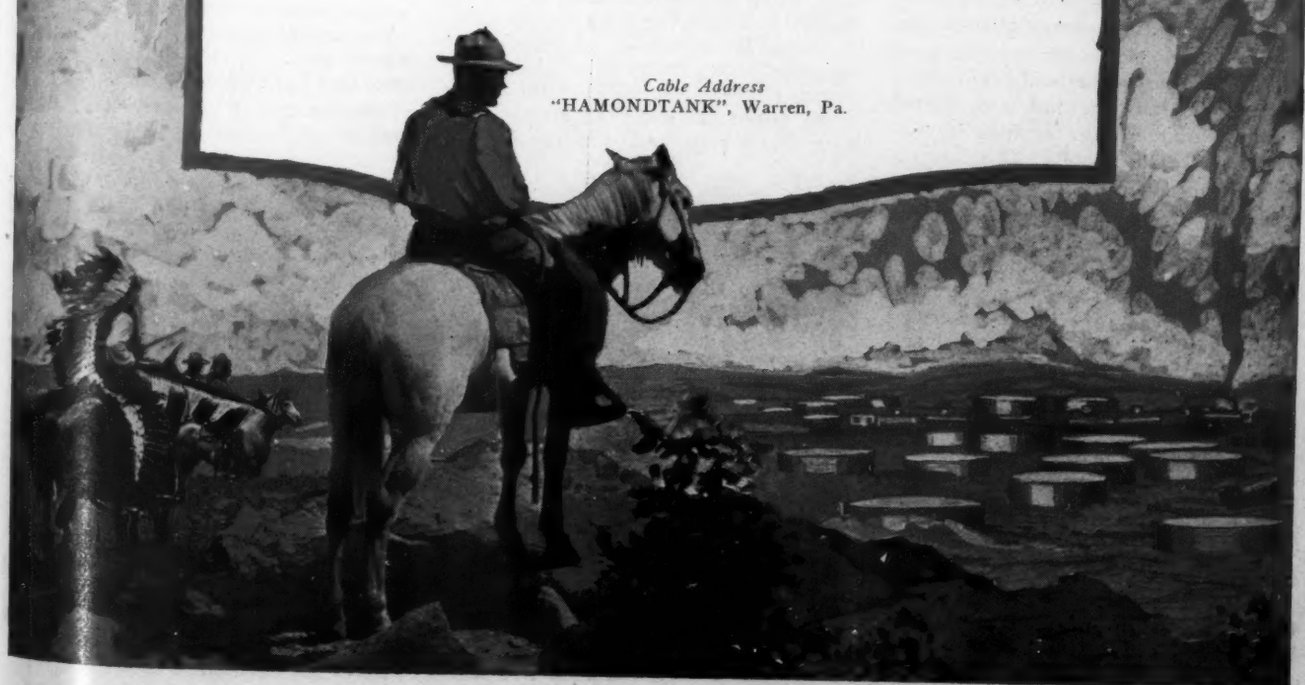

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# Treating Methods Save Equipment While Finishing Products

By GEORGE REID
*Associate Editor*

PRESSURE distillate produced by the operation of nine units of the Tube and Tank cracking process at the Bossier City plant of the Louisiana Oil Refining Corporation is chemically treated and redistilled for its gasoline yield. Each step in its processing is continuous instead of batch. Continuous chemical treatment, consists of sulphuric acid, followed by sodium hydroxide neutralization preparing the pressure distillate for redistillation. From the treating plant the distillate is conducted to treated oil tanks from which storage it is charged to the re-run battery.

The method of operating the re-run stills, their design and lay out, is a feature of interest, for the battery consists of but two 10 by 30 shell stills and conjunctive bubble type fractionating equipment, through which 6,000 barrels of relatively light oil may be processed daily. The first still in the battery is of the type known as internally fired, in that the gases of combustion first heat the bottom of the shell and are then conducted through tubes inside of the shell leading from the rear of the still to the front and out through the stack. The second still is somewhat similar in design but so modified that hot gases, although returned to the front of the combustion chamber, do not pass through the still.

Feed stock, or pressure distillate, charged to the still is split into two streams. Part of the feed passes through a preheater or heat exchange section flowing countercurrent to out-going still bottoms coming from the second still, and passing directly into the still. The other portion of the charging stock is conducted to the top of the tower working in conjunction with this still. This recycle media passes downward through the tower in counter-flow to the rising vapors from the still and acts as a temperature control. The flow of distillate through this tower is controlled by a Tagliabue automatic temperature control instrument. Bottoms from this tower also flow into the first still—which is therefore charged by the two streams, one coming in through the preheater section, and the second from the bubble tower. The stream of gasoline taken from this still is around 58-60 gravity.

### Automatic Control

Bottoms from the first still are then pumped into the middle of the second tower working in conjunction with the second shell still. This material flows downward over the bubble plates, scrubbing the rising vapors from the still, and enters the still flowing through the reflux line from the bottom of the tower. This operation is also subject to control through the operation of an automatic temperature controller. The overhead stream from the second bubble tower is received in the house at 46 to 48 gravity. The two streams are blended back to make the finished gasoline in storage tanks.

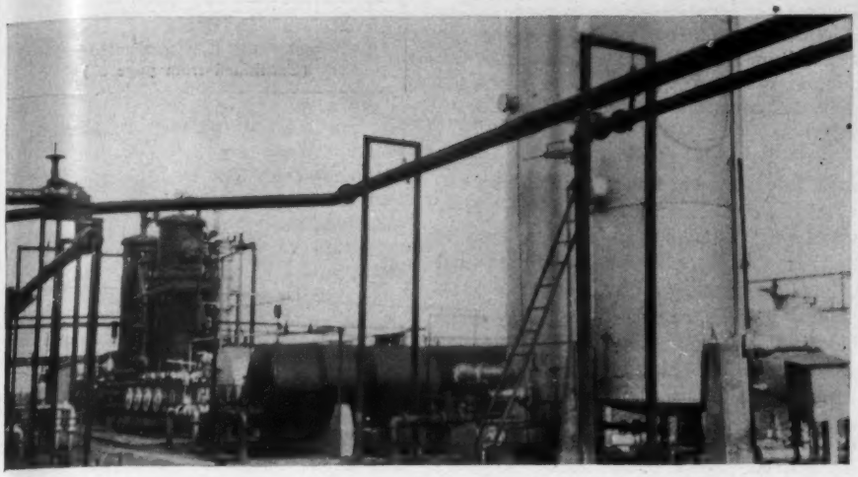
In addition to the employment of charging stock entering the stills as a temperature control medium the fractionating columns are also equipped with Southwestern temperature control sections at the top of each tower, through which water is circulated for cooling. The flow of water through these sections is also controlled by Tagliabue automatic control instruments. Control of the operation of this battery of re-run stills has been perfected with such precision that only one man is required to look after them. With furnace temperatures controlled, draft indicating instruments installed, and accurate control of the distillate recycled over the towers, as well as the cooling sections under automatic control, the labor factor in the operation of this still battery has been reduced to the minimum. Running 6,000 barrels of distillate through two stills and with one operator is certainly efficient operation.

By the insertion of small amounts of anhydrous ammonia into the vapor lines close to the point where these lines leave the bubble towers the company has greatly retarded corrosion of condensing equipment at the re-run stills. Anhydrous ammonia is received in 150 pound drums. These drums are placed at ground level, lying horizontal, and through its own pressure the ammonia vapor is conducted to the top of the tower through quarter-inch pipe and into the vapor line. This monner of installation makes for ease of operation and control of the volume of ammonia inserted into the line. Other methods sometimes employed involve the erection of high platforms for the ammonia drum to rest upon. The drums are usually difficult to reach when so placed, and generally are more or less neglected by the operating crew. Operators at the Louisiana plant have only to crack the valves permitting the ammonia to flow upward and into the line. The ammonia supply is installed close to the pumps handling oil to the stills and over the towers, and adjacent to the automatic control instruments. Being convenient for the operator on duty, he is encouraged to watch them more closely.

Sufficient ammonia is inserted into the lines to cause the collected condensate to be but slightly alkaline. In addition to accomplishing a lessening of corrosion, the experience at this plant coincides with that of others, in that the use of ammonia in this manner has resulted in the production of gasoline of more stable color. The cost of using anhydrous ammonia in this installation, based upon a price of 15 cents per pound, is about 4 cents per barrel. This cost is low indeed when the benefits accruing from its expenditure are given proper consideration. By overcoming corrosion of condenser section lines, the installation is well worth while, and no definite value can be easily placed upon the improvement in color stability of the finished gasoline.

The installation is very simple, consisting only of small lines leading from

*Continuous installation for treatment of pressure distillate prior to redistillation.*



*Absorption gasoline plant installed for vapor recovery work which produces about* 600 *barrels of gasoline daily from gases and vapors collected from the plant and cracking coils*

the ground connections of the drums, to the vapor lines at the top of the tower.

### Vapor Recivery Plant

Uncondensed gases and vapors from the nine cracking units in operation at the Louisiana Oil Refining Corporation are collected and the valuable gasoline content extracted before using these gases as fuel in the furnaces. Vapors from the receiving houses at the re-run batteries are also collected in the closed system and sent to the recovery plant. Gas for treatment in this plant derived from both sources amounts to about 3,000,000 cubic feet daily. The gasoline plant is standard Braun type, and due to its production of 25,000 to 30,000 gallons daily of high gravity gasoline which is stripped from the uncondensed vapors, it may well be spoken of as a gasoline plant instead of a vapor recovery installation, since the latter term is usually interpreted to indicate a plant with much less capacity or production. The plant is comparatively new and replaces a former installation which was torn out early in this year, part of which went into the construction of a gasoline plant at Cotton Valley, Louiana.

Four of the cracking units are operated in such a manner that the uncondensed vapors are conducted away from the receiving house and into the absorption plant under their own pressure of 25 to 30 pounds. Gases and vapors from the other five units, and from the receiving house at the re-run batteries, are "pulled" by compressor machines to the compressor plant to be boosted to the operation pressure of the absorption equipment. A slight vacuum is maintained where necessary by these machines. The compressor plant consists of two Worthington compressors, 14 by 20 by 16 inches, and four Gardner compressors, two of which are 9 by 14 by 10 inches in size and two machines 9 by 15 by 10 inches in size. The number of machines in operation depends, of course, upon the volume of gas to be handled through the plant which varies somewhat with the operating condition of the nine cracking units.

### Caustic Treatment

A scrubber tank designed by company engineers for use in conjunction with the absorption plant is of particlar interest. This device handles those gases derived from the four cracking units where pressure of about 30 pounds is maintained at the receiving house. The scrubber is constructed in two sections, each independent of the other. Gases entering the bottom section meet with a weak caustic spray and are washed by this fluid. The caustic is circulated through the bottom compartment by pump, the level in the scrubber being controlled by a Neilan-Schumacher liquid level controller. Returning to the tower from a small horizontal tank the caustic is sprayed downward through a "spider". Some oil which is carried over by the gases is caused to drop out in this compartment through the action of the spray, and some gasoline is condensed and removed to the caustic storage tank. As this oil accumulates it is conducted out of the tank and to re-run stills where the gasoline is removed. Caustic is renewed as it becomes "spent."

In the second compartment or top section of the scrubber, the gas, after passing through a number of nipples placed in the plate separating the scrubber into two sections, must pass through a spray of cool water, which is likewise circulated by pump through the tower from either of two water tanks. Condensed gasoline and oil removed from the gas in the scrubber also accumulates in the water tanks and is pumped to re-run stills. This treatment of the gases with water wash and caustic wash has done much to reduce and retard corrosion of the absorption plant equipment.

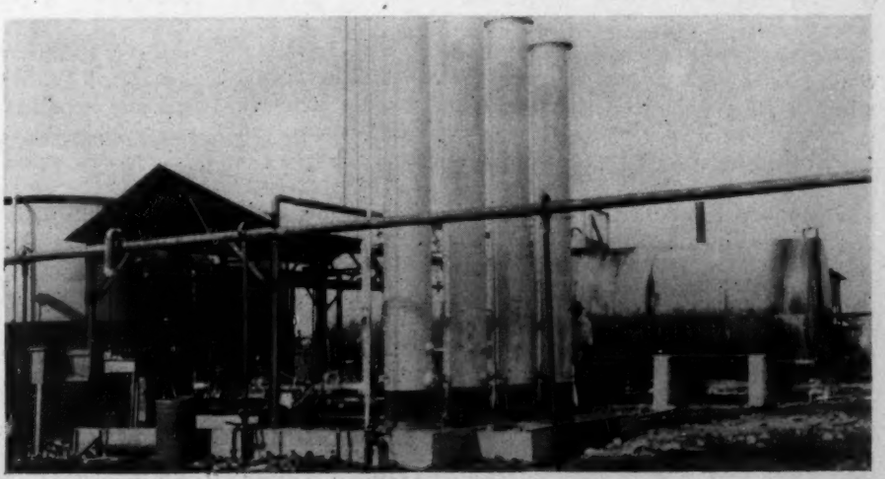
After this preliminary scrubbing with water and caustic these gases are then combined with the gases boosted into the absorption plant by the compressor machines.

With the automatic control features incorporated in the operation of the absorption plant and the efficient scrubber tank, but one operator is required to look after the absorption plant. Gas, stripped of its gasoline content, is scrubbed in the usual type of scrubber tank as it leaves the plant enroute to the furnaces.

### Light Gasoline Treating Plant

The gasoline produced by the absorption plant is transferred from nearby storage to the treating plant. This plant has been recently installed and constitutes another interesting feature of plant operation. Sodium hypochlorite is employed to treat the gasoline derived from the absorption plant. This gasoline, although produced mostly from cracking plant gases and vapors, responds nicely to chemical treatment with hypochlorite. The treating plant is one of the few hypochlorite plants designed and built to operate continuously. Much of the plant consists of salvaged materials, cleaned and repainted and put back into service, with the exception, of course, of pumping equipment. The treating columns, four in number, however, were once gasoline plant absorber towers of a type now obsolete. By cutting them in half, repairing a few leaks and applying a new coat of paint the settling tanks are as good as new but much less expensive.

Gasoline is charged to the treaters by pump, the pressure depending upon the rate of charging. This pumping carries the gasoline entirely through the treaters and into storage. At the first cylinder the gasoline is mixed with caustic solution. A small pump handling caustic discharges directly into the gasoline line—the mixture entering the "settler" at about half



*Small continuous treating plant which handles light gasoline at the rate of* 100 *barrels per hour, using sodium hypochlorite treating methods.*

of its height. Caustic settles to the bottom and is recirculated, fresh caustic being added as required.

The gasoline leaves the first treating column at the top and is conducted down to meet a second stream of chemical before it returns upward again to the center of the second cylinder. This second mixture is once used hypochlorite solution, which is not used a thrid time, but is drained off of the bottom of the second treater os it settles.

Between the second and third treaters, or treating columns, there is a master mixer head in which device the gasoline is brought into intimate contact with the fresh or strong hypochlorite solution, which is discharged into the mixer head from a small pump. The once used hypochlorite solution is reclaimed and returned to the weak solution tank for further use in the second treater. Gasoline and strong hypochlorite solution separate in the third treating column, and the gasoline is conducted from the top to the fourth treating or settling tank, meeting and mixing with a stream of cool water which washes it free of chemicals previously used. This treatment produces a gasoline that is sweet, non-corrosive to copper, and the odor is very good. The plant is subject to exact chemical control by the laboratory.

The treating plant was constructed especially to treat the gasoline from the absorption plant and has a capacity of about 100 barrels per hour. Gasoline leaving this department is finished and ready for blending with the regular plant production where it aids materially in providing the essential low boiling constituents in the finished product. With gasoline production from the absorption plant averaging 600 barrels daily, the subsequent treatment and handling of this production becomes a matter of no little importance. Under present methods the gasoline is produced, transferred, treated and stored in a closed system with the result that losses are reduced to the minimum. The recovery and utilization of such a large volume of gasoline as an indirect product of plant operation points to the greater efficiency being attained by the modern, progressive refiner.

**Zuyderhoudt Process of Low Temperature Carbonization**
(Continued from page 88)

the retorts and permitting the use of metallic retorts with no fear of sudden superheating; (2) the heat recuperation is brought about in an almost ideal manner.

"Tests on a semi-plant scale were carried out in an experimental factory installed near Brussels before a commission of French and Belgian specialists including, among others, Prof. C. Matignon. The results were encouraging. The semi-coke of Zuyderhoudt shows compactness and remarkable resistance and it can successfully replace anthracite coal in domestic heating. The fractional distillation of the primary tar gave results comparable with those obtained in the Parker fractional distillation of tar.

"It is obviously too soon to assume the technical and commercial success of the new process. We shall keep our readers informed of the results if the process becomes commercialized."

# Prevention of Corrosion Under Water

*Continued from page 78*

corrosion is most noticeable at the water inlet and decreases as the water flows through the line.

### Removing Oxygen

The removal of free oxygen or dissolved oxygen will only eliminate some of the trouble in some closed systems as there is acids in some water that are very corrosive.

Oxygen can be removed from water by chemical means, this is termed deactivation. This at first was accomplished by running water over large masses of scrap iron and then through sand filters or over steel plates in some kind of a closed vessel.

It is found that to treat the water in this way it causes the old rust in the lines to soften and finally be removed.

There are several deactivators on the market now which are very efficient in the removal of dissolved gases from water. They usually consist of a tank into which the water is first run and a coagulating agent put in it to remove some of the impurities. From this tank it goes into a steam heater which is controlled by a thermostatic valve. From this heater it goes to a deactivating tank which is filled with steel shavings, which expose about 70 square feet of metal to the cubic foot of tank space, and from this tank the water goes through a sand filter to the water mains.

It has been found that if the water is made slightly alkaline to phenolphathalein with the proper temperatures and velocity of flow that clear water can be obtained from a deactivator without the use of a filter.

It has been shown by tests that in closed water systems ordinary water with an oxygen concentration of .1 cu. c. in. per liter flowing at the rate of 1000 pounds per hour can consume 40 pounds of iron per year. In some of our boiler plants which use around 3000 pounds of water per hour according to the above figures would consume about 720 pounds of steel per year from the piping, pumps, boilers and steam lines.

The activator, it is estimated, has a life of about two years before the filling has to be renewed.

Oxygen can be removed from water by chemical means. Freshly precipiated ferrous hydroxide removes oxygen from water very quickly. Ferrous hydroxide will unit with all the oxygen in water at about 160 F. in a few seconds, however, the above treatment is very expensive.

Deaeration or mechanical removal of oxygen from water is accomplished with certain temperatures and pressure at which the gases become insoluble and rise to the top where air free steam is used to blow them away. The water is heated until there is a violent boiling, either in the atmosphere or under a small amount of pressure, if pressure is used it is so arranged that the pressure can be released periodically which cases a small amount of water to flash into steam and carries the dissolved gases away. Or the same thing can be accomplished by boiling the water under a vacuum at a lower temperature. About 95 per cent. of the dissolved gases can be removed this way but it is much more difficult to remove the last 5 per cent. Cold water can be deaerated by dividing it into a fine spray on which a high vacuum is pulled. About 80 per cent of the oxygen can be removed in this way.

In small plants with short lines it is possibly more economical to treat the systems with sodium silicate rather than to install deactivators or deareators.

The laws governing corrosion have been fairly well established, but much remains yet as to the practical details of putting them into practice.

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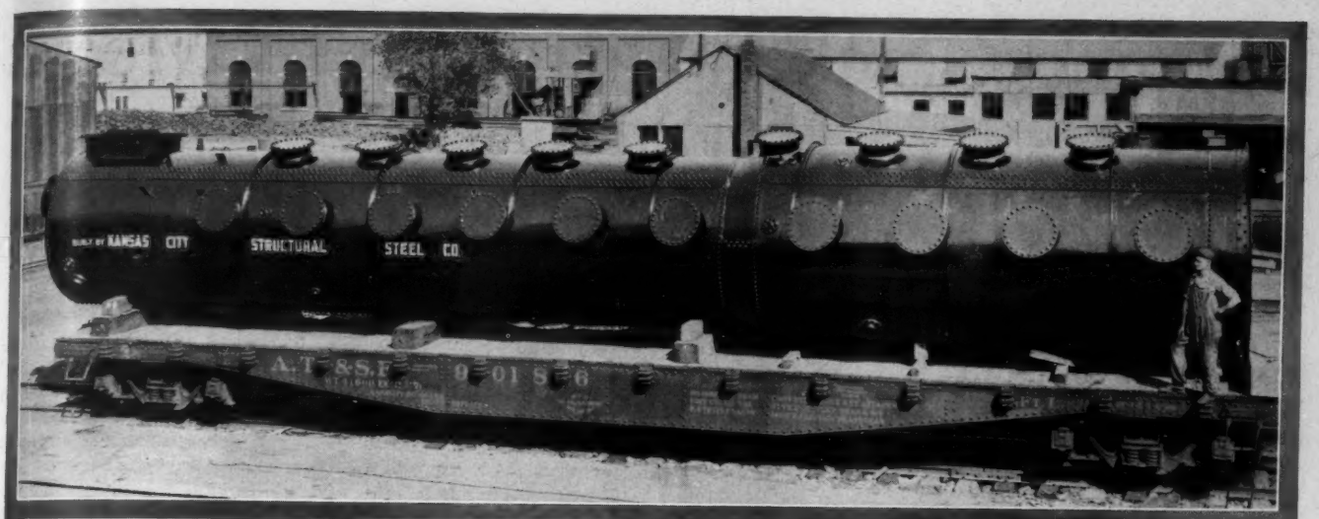
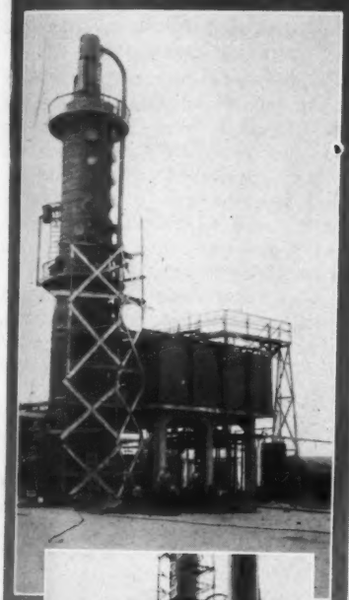
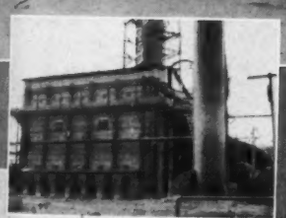
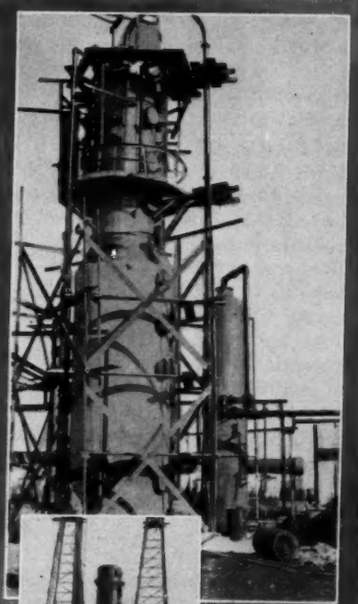
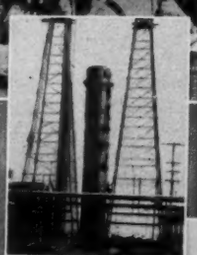
Fort Worth—H. E. Clark, district manager of the refinery division of the Graver Corporation of Texas, Arkansas and Louisiana, has resigned, effective July 1, and will at that time assume charge of sales for the Motor Fuel Products Company of Laredo. His position with the Graver Corporation will be filled by C. L. Marner, who is now with the company in charge of the refinery and tank division at Tulsa.









# Bubble Towers

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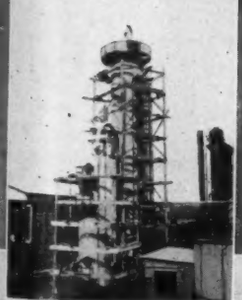

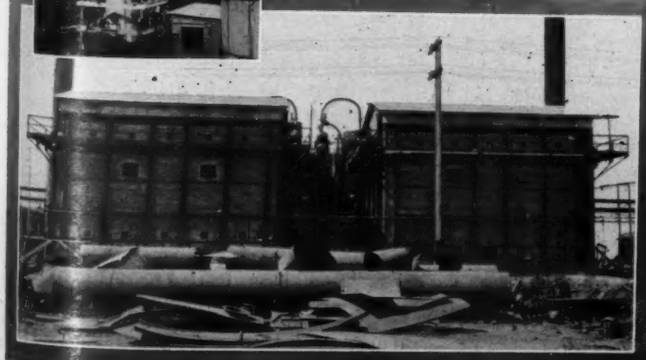

# Refining Cracked Distillates by Means of Hypochlorite

By STANLEY FRANCIS BIRCH and
WOODFORD STANLEY GOWAN PLUCKETT NORRIS
*Anglo-Persian Oil Company, Ltd.*

EXPERIMENTS on the action of hypochlorite solutions on petroleum solutions of pure sulphur compounds (Journal of the Chemical Society, 1925, 127, 1934) have led to the following conclusions:

*Hydrogen sulphide* is oxidized to elementary sulphur, with simultaneaus formation of a small quantity of sulphuric acid. The free sulphur is not further attacked. This reaction is not affected by the presence of alkali.

*An organic sulphide is* oxidized to the sulphone, which, being neutral, becomes disturbed between the hydrocarbon solvent and the aqueous reagent according to its solubilities in these two solvents. No acid product has so far been detected. The reaction is qualitatively unchanged with changing alkalinity of the hypochlorite, but the oxidation of the higher sulphides is appreciably retarded by an increase in alkali content.

It can be shown that a *mercaptan* is oxidized in two stages, by making the hypochlorite solution strongly alkaline, whereby the second reaction is retarded and therefore, in effect, largely inhibited. In the first stage the mercaptan is oxidized mainly to the disulphide, although sulphuric acid, the sulphonic acid, and traces of a petroleum-soluble substance containing chlorine, are also produced. The velocity of this first stage in the oxidation of a mercaptan is practically independent of the alkalinity of the hypochlorite, although there is a tendency to the exclusive formation of the disulphide as the alkalinity increases. The disulphides are oils of comparatively sweet odor; moreover, they are not reactive to sodium plumbite ("doctor") solution. Hence, although the disulphide remains dissolved in the oil, the latter is already sweetened (both in odor and to the doctor test) at this stage of the oxidation.

### Second Stage

The second stage in the oxidation of mercaptans is the oxidation of the primarily-formed disulphides, which are also produced during the soda-washing of certain distillates and probably also during the distillation of many crude oils. The *disulphides* are converted by hypochlorite solutions into the sulphonic acids, with simultaneous formation of smaller quantities of sulphuric acid. The oxidation is greatly retarded by free alkali and is almost completely inhibited if sufficient alkali is present (it is for this reason that for desulphurizing petroleum the alkalinity of the hypochlorite must be kept low.) As the oxidation proceeds the acid products, which are almost completely water-soluble, neutralize the free alkali of the reagent and so progressively accelerate the reaction.

It follows that desulphurization is best accomplished by the use of hypochlorite solutions containing only sufficient free alkali to render them stable enough to be employed without the occurrence of spontaneous decomposition, but that "sweetening" should be possible by the use of solutions containing enough free alkali to prevent the oxidation of disulphides.

Treatment of a cracked distillate by means of reactive hypochlorite solutions generally employed for desulphurizing straight-run gasolines often leads to chlorination and to the formation of oxidation products which are an additional cause of reversion and gumming. The term "chlorination" as applied to the effect of hypochlorite solutions on cracked distillates, is hardly apt. Chlorine is more likely to be present in a hypochlorite-treated cracked distillate in the form of chlorohydrins, produced by the addition of hypochlorous acid to unsaturated hydrocarbons whereas the term "chlorination" is usually applied to the production of a chloride by substitution. Free hypochlorous acid is always present in hypochlorite solutions, being produced together with alkali by the hydrolysis of the alkali hypochlorite:

$$NoOCl + H_2O \qquad NaOH + H\ O\ Cl.$$

Since this reaction is reversible the addition of free alkali causes a decrease in the concentration of hypochlorous acid. The tendency to "chlorinate" the hydrocarbons of the cracked distillate should therefore be lessened by adding free alkali to the hypochlorite solution, and since alkaline hypochlorite solutions have been shown to have a "sweetening" action, their use should prove an excellent means of refining cracked distillates.

### Eliminates Free Sulphur

This application of the hypochlorite process would then be analogous to the practice of refining by means of sodium plumbite and elementary sulphur, but would be free from the danger of free sulphur finding its way into the finished product; both processes depend for their sweetening action on the conversion of thhe malodorous mercaptans into the comparatively sweet-smelling but high boiling dissulphides. But by the use of hypochlorite solutions, oxidation of the sulphides to sulphones may also occur (which is not possible when plumbite is employed) and this is to be desired, since sulphides, although "sweet" to doctor, are not necessarily sweet in odor and may, in comparatively high concentrations, impart a slightly sour smell to the petroleum. Hypochlorite is, moreover, less expensive than plumbite, and offers the further advantages that no sludge is formed and that the installation of a recovery plant is not necessary.

Comparative experiments were therefore carried out on the refining of a pressure distillate prepared from Persian 60 per cent residue. The distillate, which was brown and possessed a characteristic odor, had specific gravity of 0.769 at 60 degrees F.; was volatile at 200 degrees C., leaving a high-boiling residue. The treatments given were:

(1) ½ per cent acid; 1 per cent plumbite; redistillation to 185 degrees C.; soda.

(2) ½ per cent acid; 1.5gm available chlorine litre; redistillation to 185 degrees C.; soda.

The following properties for the finished products are the result of two typical experiments:

| | 1. | 2. |
|---|---|---|
| Color | White | White |
| Odor | Good | Good |
| Sulphur per cent | 0.084 | 0.073 |
| Sp. Gr. | 0.743 | 0.737 |
| Gum[1] | 0.0001 | 0.0003 |
| Doctor Test | Sweet | Sweet |

It can be seen that the use of hypochlorite gave quite a satisfactory product. No chlorination was observed. In these and the following experiments the distillate was tested for chlorination by burning 1 c.c. in a previously ignited copper scoop (made roughly from foil) and then heating in a Bunsen flame; the flame indication of copper halide was comparable, when "chlorination" in the special sense had not occurred, with that obtained from a hypochlorite-treated straight-run distillate of which the chlorine content was 0.01-0.02 per cent.

In subsequent work the pressure distillate was given an initial soda-wash to remove hydrogen sulphide, which would otherwise be converted into free sulphur by the action of hypochlorite or (partly) by the action of sulphuric acid. The production of elementary sulphur is, of course, to be avoided, and the initial soda-wash is now regarded as essential for, apart from its effect on the quality of the product, the use of a preliminary soda-wash effects economy in hypochlorite.

### Advantage of Reversing

Although there are advantages in giving the acid wash before the hypochlorite (e.g. economy in chlorine), theoretical

[1] All figures for gum represent grams of gum obtained by the evaporation of 25 c.c. gasoline in a porcelain basin on the steam bath followed by 20 minutes in the steam oven and subsequent cooling in a desiccator.

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*equipment* predominates

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considerations indicate that better results should be obtained by reversing the treatments, because (a) the possibility of traces of acid or of acid products coming into contact with the hypochlorite—tending to produce chlorination—is avoided (b) the acid would, at least partly, remove any oxidation products formed by the hypochlorite and thus the gum content of the finished gasoline should be slightly lower. Comparative experiments showed that distillates refined by the two processes: (1) soda: acid: hypochlorite: redistillation: soda (2) soda: hypochlorite: acid: redistillation: soda were very similar in sulphur and gum content, but that the second process gave a product of slightly superior odor.

Crude Cracked Petroleum Distillate
S=0.20%
Soda washed distillate S=0.17%
½% acid S=0.14% 1.5 gms chlorine litre
S=0.16%
[2].25 gms chlorine litre
S=0.13% ½% acid S=0.13%
Distillation (without Steam)
S=0.06%
Distillation (Without Steam)
S=0.07%

Redistillation on the laborator scale was carried out without the aid of steam, since steam distillations are practically impossible to standardize.

| | (1) | (2) |
|---|---|---|
| Sp. Gr. | .745 | .744 |
| Pct. Sulphur | .06 | .744 |
| Gum | 0.0015 | .07 |
| Color | Water white | Water white |
| Odor | Good | Better than (1) |
| Residue | Yellow; no carbon | Yellow; no carbon |

In all subsequent work the second procedure was adopted.

The quantity of alkaline hypochlorite was always carefully regulated, after preliminary tests, only sufficient being used to sweeten the soda-washed distillate (about 1.4 grams available chlorine per litre of distillate.) There is consequently little waste of chlorine, either by its use in unnecessary desulpherization or by loss in the effluent. Moreover, there is the advantage that in refinery practice the crude distillate and the hypochlorite may be passed counter current to each other through a suitable plant, whereby the incoming crude distillate is met by exhausted hypochlorite, i.e., a solution of caustic soda (or of lime, if calcium bleach is employed); thus the initial soda-wash and the hypochlorite wash may be combined and effected by means of the same aqueous solution:

Crude distillate
soda-washed distillate
sweetened distillate.
Alkali (+chloride)
alkaline hypochlorite.

(This combination could not be effected if acid were given before hypochlorite, *v.s.*). The time required for sweetening is very short and depends, for practical purposes, solely on the effectiveness of mixing—unlike desulphurization by means of hypochlorite which, even with practically perfect mixing, requires an appreciable time. In the hypochlorite wash an advantage appears in using a concentrated hypochlorite solution; the higher the content of available chlorine the more spirit can be sweetened by contact with a given volume of the reagent and hence the greater the throughput.

[2]These quanaities represent the minimum chlorine treatment found by trial to give a perfectly sweet product; the economy of chlorine in the first process is evident.

### Method Adopted

The sequence of treatments finally adopted in the laboratory was as follows:

(1) Soda wash, usually 1 per cent of 10 per cent soda.
(2) Hypochlorite wash, the minimum for sweetening.
(3) Acid wash, ¼ per cent to 1 per cent.
(4) Water wash, 5 per cent.
(5) Soda wash, 1 per cent of 10 per cent.
(6) Water wash, 5 per cent.
(7) Redistillation to required final boiling point.
(8) Dilute soda wash, 5 per cent of 0.5 per cent.
(9) Water wash.

Although the process at first appears cumbersome, it is no more so than the sequence of treatments described by Morrell (Ind. Eng. Chem., 1926, 18, 733).

### Refining Cracked Distillate From a Cross Plant

The distillate was prepared from Persian gas oil in a Cross plant. It was very pale yellow and possessed a highly unpleasant, sour odor, owing to the presence of mercaptans and of hydrogen sulphide. The sp. gr. was 0.735 at 60 degrees F. and the sulphur content 0.0 per cent.

Preliminary experiments showed that this material had but little tendency to become chlorinated even with comparatively weakly alkaline sodium hypochlorite solutions. In fact, even with solutions of alkalinity corresponding with that of saturated lime water the hydrocarbon constituents were not appreciably attacked. Consequently it was possible to sweeten this distillate (after a preliminary soda-wash, of course) by the use of a concentrated solution of calcium hypochlorite, saturated with calcium hydroxide, this solution being prepared by saturating cold water with commercial bleaching powder. Excepting that this concentrated calcium hypochlorite solution replaced the alkaline solution of sodium hypochlorite, the refining treatment followed that given above:

(1) Soda wash, 1 per cent by volume of 10 per cent caustic soda.
(2) Water wash, 5 per cent.
(3) Calcium hypochlorite wash—1.5 grams available chlorine per litre of distillate was given (1.47 gm/litre absorbed), using a solution of normality (available chlorine) 2.026, saturated with lime.
(4) Acid wash (C.O.V.)
(a) ½ per cent.
(b) 1 per cent.
in each experiment the acid being given in two parts—first ¼ per cent followed by sludging, then (a) ¼ per cent (b) ¾ per cent, respectively, and a second sludging.
(5) Water wash, 5 per cent.
(6) Soda wash, 1 per cent of 10 per cent.
(7) Distillation without steam, through a packed column, to 185 degrees C.
(8) Soda wash, 5 per cent of 0.5 per cent caustic soda.

### Finished Products

The properties of the finished spirits were as follows:

| | ½% acid | 1% acid |
|---|---|---|
| Color | Water white | Water white |
| Odor | Pleasant | Pleasant |
| Sp. Gr. | 0.742 | 0.742 |
| Sulphur Pct. | 0.06 | 0.035 |
| Gum | 0.0026 | 0.0012 |

These products, which were in every way acceptbale, proved reasonably stable on keeping.

Analyses of the distillate at different stages of refining gave the following results:

| | % S. | S.G. @ 60°F. |
|---|---|---|
| Original distillate | .20 | .735 |
| After soda (1% of 10%) | .17 | .735 |
| After soda and hypo (1.5 gm/litre) | .16 | .735 |
| After soda and hypo and ½% acid | .13 | .747 |
| After soda and hypo 1% acid | .17 | .747 |
| After soda and hypo ½% acid, and distillation to 185°C. | .06 | .742 |
| After soda and hypo 1% acid, and distillation to 185°C. | .035 | .742 |

The results show that the desulphurizing is not due to the hypochlorite but rather to the combined effect of acid followed by redistillation. The acid removes certain organic sulphides but, owing to its own tendency to form alkyl sulphates, the reduction in sulphur content of the distillate does not occur until after distillation, when these unstable compounds either remain in the residue or are decomposed. This conclusion was confirmed by the results of a series of experiments in which a distillate, prepared by cracking Persian gas oil, was given varying quantities of sulphuric acid, followed by redistillation. The sulphur contents of the finished products (after a final soda-wash) were clearly grouped according to the acid given.

### Gum Formation

Moreover, the quantity of acid used also conditions the gum formation on exposure of the finished gasolines to subdued daylight. In three parallel experiments the same cracked distillate from Persian gas oil was given 2.4 grams available chlorine per litre, followed by ¼ per cent, ½ per cent and 1 per cent sulphuric acid, then redistilled to 185 degrees C. and finally washed with soda and water. The figures for gum formation were as follows:

| Gum: | ¼% | ½% | 1½ |
|---|---|---|---|
| Freshly prepared product | 0.0003 | nil | nil |
| After 14 days | 0.0056 | 0.0021 | 0.0008 |
| After 28 days | | 0.0079 | 0.0045 |

The increase in stability towards light with increase in the acid given is very striking.

### Stability of Color

This test—the usual one—of noting how rapidly the finished cracked gasoline deteriorates on exposure to daylight is carried out under conditions to which a commercial spirit is never submitted in practice, and is considered unnecessarily drastic; observation of the behavior in the dark but in the presence of air would be preferable. The same hypochlorite-treated cracked gasoline from Persian gas oil was

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given ½ per cent acid, followed by redistillation to 185 degrees C. The soda-washed distillate did not contain a weighable quantity of gum, the color was water-white, and the odor pleasant; sp. gr. 0.735. Samples were now kept (1) in subdued light (2) in the dark, with the formation of the following quantities of gum:

| | (1) | (2) |
|---|---|---|
| After three weeks | 0.0027 | nil |
| After six weeks | 0.0060 | nil |

It is evident that this spirit, whilst satisfactory in every way and perfectly stable under commercial conditions, reverted under the influence of light; this confirms the conclusion that stability to the "light" test is an unfairly severe criterion of refining of a cracked gasoline.

The finished gasolines refined by the methods here outlined showed satisfactory behavior towards a polished strip of copper—there was no corrosive action visible even after many weeks.

### Refining of Various Cracked Distillates Produced in Autoclave Experiments

Illustrations are tabulated below of the application of the same general scheme of refining to varius pressure distillates produced in an autoclave. The tendency to chlorinate was again so low that calcium hypochlorite solution saturated with lime could be employed as sweetening agent. The results are interesting inasmuch as they show the wide range of different types of cracked distillates which have been successfully refined using the general scheme of treatments: soda, hypochlorite, acid, redistillation.

| Cracking Stock | Treatments: Crude Dist. F.B.P. 200°C. Initial soda 1% of 10% Calcium Hypochlorite saturated with lime, available chlorine 6.982%. Acid (C.O.V.) ½% by vol. Final soda, 10% of 0.5%. Refined Gasolines Color: water-white. Gum: nil. Doctor Test: Sweet. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | S. G. | %S. | gm Cl/L given | Redistilled to | S. G. | Odor | HCl during redistillation | % S |
| Roumanian Fuel Oil 1 | .754 | .092 | 1.0 | 175°C. | .736 | Very good | Faint trace | .02 |
| Roumanian Fuel Oil 2 | .751 | .07 | 1.0 | 175°C. | .736 | Very good | Nil | .034 |
| Californian Kerosene | .788 | .10 | 0.75 | 196°C. | .785 | Good but peculiar (sharp) | Trace | .006 |
| Trinidad Fuel Oil | .776 | .11 | .05 | 190°C. | .763 | Good | Nil | .05 |

It has been generally observed, that the odor of a finished gasoline is chiefly a function of the hypochlorite employed. The production of a product of satisfactory color depends, however, upon the use of sufficient acid, but even more upon careful redistillation. Attempts to avoid redistillation (with its attendant heavy loss owing to non-condensation of light vapor) by the use of clay or of weaker acid did not prove successful.

### Refining of Cracked Distillate From Persia Gas Oil

The cracking stock, approximating to a gas oil, was derived from various fractions obtained by the distillation of Persian crude oil. The pressure distillate produced by the Cross plant was pale yellow in color and had the following characteristics: Specific gravity, .736 at 60 degrees F.; distillate to 100 degrees C., 30.5 per cent; final boiling point, 185 degrees C.; sulphur, .17 per cent.

The treatment followed the procedure described above. Continuous countercurrent washing was adopted for the initial soda wash and for the hypochlorite treatment. The quantity of soda used amounts to about 1 per cent of 10 per cent of soda. A 5 per cent wash of .34 N calcium hypochlorite solution was employed the alkalinity being .04 gm. calcium hydroxide per litre (0.6 gm. chlorine per litre of distillate).

Acid washing was carried out on 10,000 gallon batches which were given two successive washes of 0.25 per cent C.O.V. This was followed by a wash of 1 per cent of 10 per cent soda until neutral and then a 5 per cent water wash.

The treated pressure distillate then had the following characteristics: Specific gravity, .743 at 60 degrees F.; distillate to 100 degrees C., 27 per cent; final boiling point, 205 degrees C.

The distillation was carried out in 10,000-gallon stills, using both open and closed steam, at a still temperature of 110 degrees C. After a 20 per cent wash of 0.5 per cent soda the finished gasoline possessed the following characteristics: Color, water-white; odor, good; specific gravity, .726 at 60 degrees F.; distillate to 100 degrees C., 31 per cent; final boiling point, 183 degrees C.; sulphur, .04 per cent; gum 12 mg.[a] per 100 c.c. gasoline.

The residual oil from the stills was yellow in color and had a specific gravity of 0.811 at 60 degrees F., and a sulphur content of 0.37 per cent.

### Refining of Cracked Distillate From Trinidad Gas Oil

The pressure distillate had the following characteristics: Specific gravity, 0.812 at 60 degrees F.; distillate to 100 degrees C., 11 per cent; final boiling point, 219 degrees C.; sulphur, 0.125 per cent

The treatment given was as follows:

a. Agitation with 1 per cent of 10 per cent soda.

b. Agitation with 5 per cent water.

c. Agitation to exhaustion with 11.5 per cent of 0.34 N calcium hypochlorite solution of alkalinity .04 gms calcium hydroxide per litre (1.38 gms chlorine per litre of cracked distillate).

d. Agitation with 5 per cent water.

e. Two consecutive washes with ¼ per cent C.O.V.

f. Agitation with 1 per cent of 10 per cent soda until neutral.

The distillate at this stage had the following characteristics: Specific gravity, 0.827 at 60 degrees F.; distillate to 100 degrees C., 9.1 per cent; final boiling point, 238 degrees C.

Distillation was carried out at a temperature of 130 degrees C., using closed and open steam. The gasoline was finally given a wash of 20 per cent of 0.5 per cent soda.

The finished gasoline was water-white and of good odor. It had specific gravity 0.800 at 60 degrees F.; distillate to 100 degrees C., 14 per cent; final boiling point, 212 degrees C.; sulphur, .04 per cent; gum, 4 mg per 100 c.c. of gasoline.

The residual oil had specific gravity .887 at 60 degrees F. and a sulphur content of .35 per cent.

Our thanks are due to Dr. Dunstan and Dr. Thole for helpful suggestions from time to time and to the Anglo-Persian Oil Company, Ltd., for permission to publish these results.

[a] Another batch of this distillate, treated similarly, gave a gum content of 1.4 mg. per 100 c.c. gasoline.

## CONCRETE FLOORS

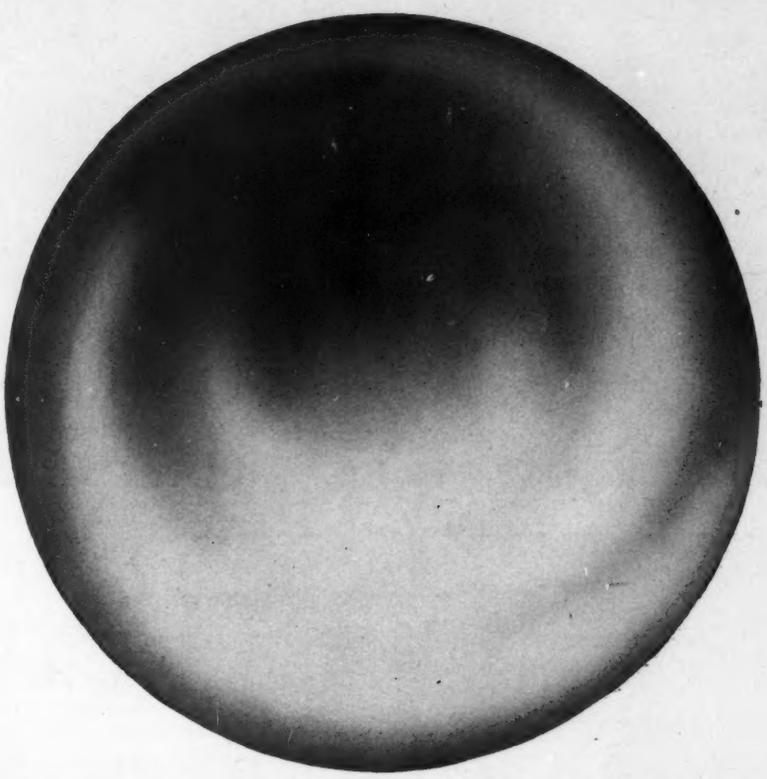
"Plain Talk About Concrete Floors," is the title of a booklet just published by The Master Builders Company, Cleveland, Ohio. The Engineering laboratories of the Ohio State University have cooperated in supplying the information by reporting extensive abrasion tests of cement floor finishes of different types. The book has approximately 40 pages and carries over 50 illustrations. The subject matter includes specific facts and figures obtained from owners, on initial costs and upkeep expense. Copies of the booklet may be obtained by writing the manufacturers.

Maintenance Engineering Corporation, Houston, announces connection with the Cleveland Brass Manufacturing Company, Cleveland, Ohio, manufacturers of Barrett Acimet Valves, especially designed for the handling of acids and other corrosive liquids. They will maintain a complete stock of the valves.

Philadelphia. — Atlantic Refining Company has contracted to sell its holdings in Superior Oil Corporation stock, which it owns in the name of the Atlantic Oil Producing Company, a wholly owned subsidiary. The purchaser of the Superior stock has not been made known as yet, however.

Los Angeles.—Oil Engineering Company of this city has been incorporated under the name Hydrocarbon Apparatus, Inc.

# BALLS
# Hollow–Solid



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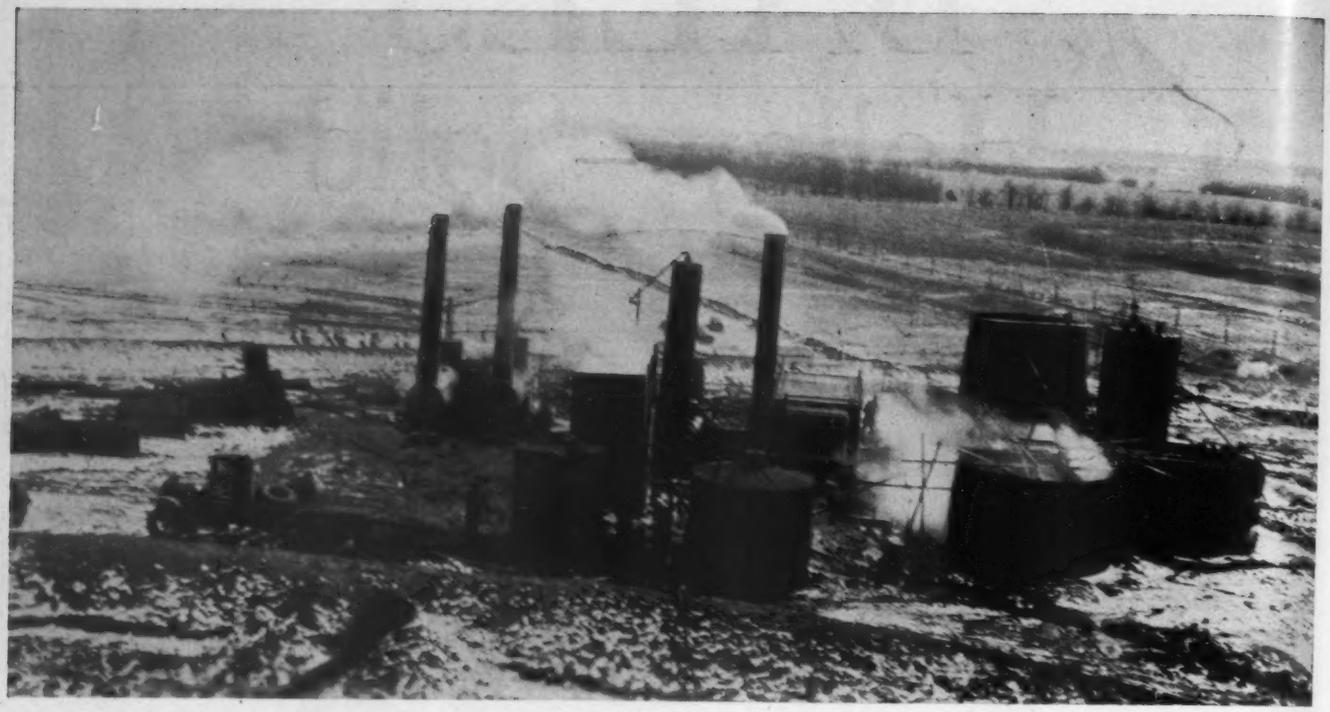
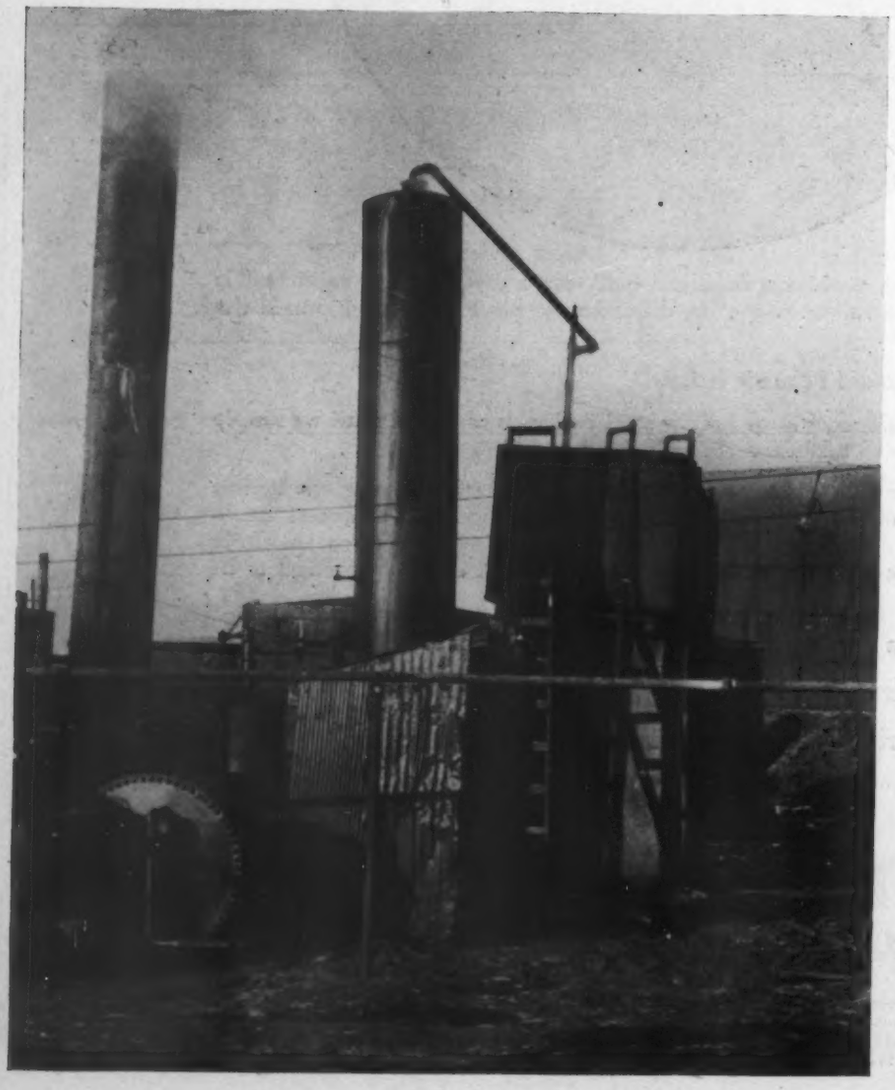
# Running Tank Bottoms





*Above is the general layout of plant. Below—A close-up of the Condenser.*

Edgecomb and Scanlon, independent operators of El Dorado, Kansas, are recovering approximately 50 per cent. fuel oil and naptha from tank bottoms which have been accumulating in steel storage and earthern ponds for the past 15 years. A plant erected early this year on the Oklahoma Pipe Line Company's Loomis tank farm, six miles southwest of El Dorado, in the Towanda field, started operations late in February to handle between 400,000 and 500,000 barrels.

The process of running the emulsion is straight distillation, handling it direct through a three-inch pipe still of the operators' own design. They are running steady at an average rate of 2400 barrels daily, using initially one still with plans for the second being erected.

Inasmuch as the project involves ridding the storage of the "bottoms," thus giving the tank farm owners a storage cleaning job, the cost of the raw material is not excessive. Another point of convenience is that one 55,000-barrel steel tank is accessable for storage by the operators. Another tank of this capacity was obtained in the purchase, giving them 110,000 barrels storage capacity for fuel oil. The naphtha is temporarily being stored in small wooden tanks.

The raw "bottoms" is solid at 80 F. to the point of holding the average man's weight, and at 100 F. can be flowed. Their method of moving the

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*Still in the Edgecomb and Scanlan plant*

material is through a three-inch pipe to the still, with a two-inch steam line laid in the same ditch. A 10x4½x10 Worthington pump is used in picking up the accumulation for removal to the still. A Worthington 6x4x6 hot oil balanced valve pump picks up the emulsion from the still into the vaporizer.

There is no steam loss in the process. After running the pumps, the steam exhausts into the tank for heating the emulsion as it is transferred to the plant. Condensing of steam in the tank keeps it full of hot water, from which it is run back through the boiler.

The emulsion is being heated as high as 650 degrees F., according to the nature of the various layers. A pressure of around 30 pounds is maintained through the still, while the steam pressure in the heating line is held at from 75 to 125 pounds, depending on the requirements for moving the "bottoms".

A 3x28-foot vaporizer takes the flow from the still, and separates the fuel products from oil and water vapor. Vapors are conducted thence to the condenser, the fuel oil to storage and residium, of which there is a negligible quantity, is trapped out. From the condenser the water and naptha moves into a gaso-water separator, from which the water is bled out the bottom, soft and pure, for boiler water. The light oil tests 45 gravity. There is no trace of water nor sediment in the finished fuel oil.

The fuel oil requires a heat treatment when moved from storage to a loading rack, two miles away, and is moved through a three-inch flow line with a two-inch steam line inside.

---

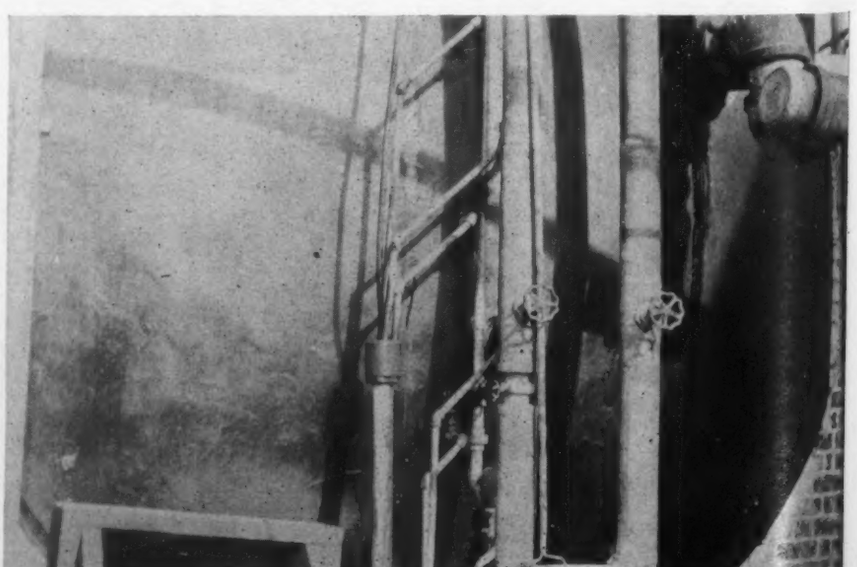
Amarillo, Texas.—A new 20,000-gallon gasoline plant is being built at Channing on the new Amarillo-Denver gas line by the Canadian River Gas Company, and will be ready for operation when the gas line is completed. Specifications for the plant were provided by Jackson Engineering and Equipment Company.

Several methods are employed by refiners in equipping shell stills with devices for determination of oil level in the retort. One of the essential and important factors for consideration is that of providing leak-proof equipment and some means for carrying away the small amount of oil spilled when oil level inspection is made by the stillman.

The accompanying photograph illustrates one method by which a California refiner has overcome the usual objections to open liquid level indicating valves, and reduced the fire hazard materially in that common danger zone behind the stills.

In this instance the still shell at the rear has been tapped at evenly distributed points with half-inch holes in vertical alignment. Half-inch nipples were screwed into the holes, and half-inch needle valves placed on the small line. From the needle valves, half-inch lines lead diagonally downward to a large cup. The cup consists of a collar somewhat larger than the drain line and a reducer. As is shown in the photograph, several of these small lines drain into a single receiving cup. From this cup the oil drains into the sewer line and to a trap where it is reclaimed.

When the stillman inspects the battery for oil level he opens the valve and if the oil "shows" it is conducted into the cup-like nipple and away to the sewer. Such practice makes for cleanliness behind the stills, and prevents the accumulation of oil on the ground with its accompanying fire hazard. In the event of a leaky valve, the drippings are not blown around on hot oil lines, etc., to cause a flash, but are conducted away until such time as the leak may be repaired. The device is an improvement over the old style brass pet cock which ejected its vapor and oil into the atmosphere when the stills were tested for oil level, and which had a tendency to leak at all times and which were often found with the cores loosely inserted and ready to drop out.



*Device for determining oil level of shell stills which reduced the fire hazard and aids in keeping the distillation equipment clean.*

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## HIGH TEMPERATURE CEMENT

General Refractories Company, 106 S. 16th Street, Philadelphia, has published a new booklet called "Choosing a High Temperature Cement." The booklet discusses various types of high temperature cements, their resistance or non-resistance to slag attack, their resistance or tendency to shrinkage and spalling, their performance at high temperatures, their suitability for patching and monolithic structures, and shows illustrations of comparative tests on various types of cement.

Copies may be secured from the manufacturer, by request.

---

To provide larger and more efficient quarters the Los Angeles sales offices of Hill, Hubbell & Company, Pacific Coast Paint Manufacturers was moved on June 1, from 331 West 11th Street, to the Petroleum Securities Building, 714 West 10th Street.

# STOCKHAM FITTINGS

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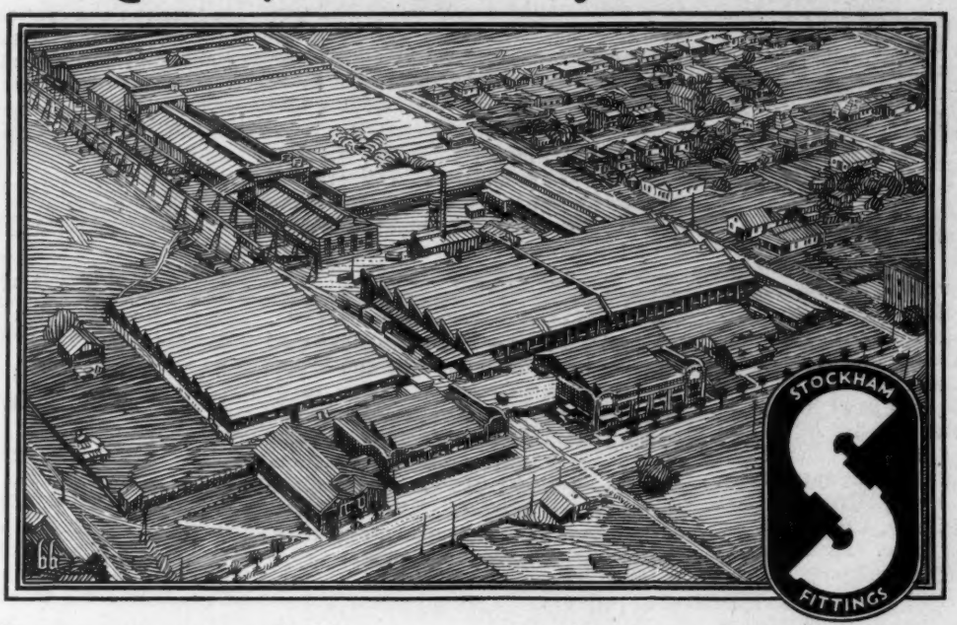


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# REFINERY AND GASOLINE PLANT ACTIVITIES

*New Plants – Construction Notes – Personnel Changes*

### ATLANTIC SEEKS REFINERY SITE

Houston.—For the purpose of inspecting prospective sites for a large terminal and refinery on the Houston Ship Channel, various officials of the Atlantic Refining Company will arrive in Houston on Thursday of this week, according to a statement issued to the press on Tuesday by M. C. Ehlen, vice-president of the Crown Central Petroleum Corporation, who requested at the same time that land owners with probable sites arrange for interviews with the visiting officials.

Conflicting with the above announcement of plans, a report was circulated Tuesday to the effect that Harry W. Gilbert of Beaumont, chairman of the Beaumont-Port Arthur Industrial Commission, had learned from Atlantic officials that the company had already located a refinery site at Port Atreco on the Neches River between Beaumont and Port Arthur. The Atlantic has a crude oil terminal at Atreco, and, according to Mr. Gilbert, has purchased 1100 acres of land there. He also stated that the Atlantic Company has received a permit from the county commission to lay a pipe line under Jefferson County roads, and that there was to be a meeting Friday to work out a schedule of taxation. The pipe line to the Atreco refinery site, he said, is under construction and will have 30,000 barrels daily capacity, the route being from Midland in West Texas, a distance of 528 miles. Mr. Gilbert's information was that the refinery will cost $20,000,000 and employ 2500 men.

### EL PASO PLANT STARTS

El Paso, Texas.—The Pasotex Petroleum Company, subsidiary of the Standard Oil Company of California, has completed construction of the 10,000-barrel skimming plant near here, with the initial crude runs scheduled for July 10. Materials for this plant were purchased about January 15, 1928, and the erection was completed on schedule.

Crude supply for this plant is being supplied by the Pasotex Pipe Line Company's eight-inch line from the Hendrick field, West Texas, a distance of about 195 miles. Six 55,000-barrel and two 30,000-barrel steel tanks have been erected at the refinery for crude storage.

Fuel oil produced from this plant will be sold locally and to railroads entering El Paso, while the gasoline will be marketed under Standard Oil Company of California's trade name of Red Crown, with distribution extending into West Texas west of the Pecos River, Mexico, New Mexico, Arizona and other Rocky Mountain States.

The Pasotex Petroleum Company has purchased 12 bulk and service stations operated by the Gulf Refining Company west of the Pecos River in West Texas, and New Mexico, since Gulf is withdrawing from this territory because of disadvantage of freight rates in shipping from its Port Arthur and Fort Worth plants.

W. G. Hamilton, formerly superintendent of Standard's refinery at Richmond, California, is manager of the El Paso plant, and also supervised construction work.

### SOUTHWEST PLANT STARTS

Laredo, Texas.—The new 1000-barrel refinery being built here by the Motor Fuel Products Company is due to be in operation about August 15. It will operate on Mirando crude, refining gasoline and other light end products, and the products will be marketed locally and in Mexico. S. B. Coblentz is president of the company, and H. E. Clark will be sales manager.

### NATURAL GASOLINE TEST

Tulsa.—Official specifications of the Natural Gasoline Association of America will be changed on July 1 to include the doctor test on all grades. The following resolution defining the method of testing has been adopted by the specifications committee of the association:

"Doctor sweet natural gasoline shall meet the requirements of and be tested according to Method 520.3 doctor test (sodium plumbite) as published in technical paper 323-B, revised by the Department of the Interior, Bureau of Mines, October 21, 1927, with the added requirement that the reagents used in the test shall be chemically pure. Extreme care must be taken in storing all chemicals and the sodium plumbite solution in strictly clean, tightly closed receptacles and a glass stoppered bottle shall be used for making the doctor test."

### ENLARGE PLANT

Tulsa.—Capacity of the Forrest E. Gilmore Company plant in the Seminole area in Section 35-8-6 will be increased from 16,000 to 20,000 gallons daily through the addition of three 180-horsepower Clark compressors. The Gilmore Company plans to build a new plant in the South Little River field, its fifth in the Seminole area. Production from its four plants now operating is over 20,000 gallons daily.

### RICHFIELD ENLARGES

Los Angeles.—The Richfield Oil Company of California has greatly increased its refining facilities and now ranks third in the State in the sale of gasoline and lubricating oils through purchase of the outstanding Class "A" stock and a substantial block of the "B" shares of the Pan American Western Petroleum Company from the Petroleum Securities Company and Edward L. Doheny.

The Richfield company has five refineries, located at Riorco, Huntington Beach, Los Angeles, Bakersfield and Fellows; and the output of these plants, together with that of Pan American's refinery at Watson, will give Richfield a total refining capacity of 142,000 barrels daily. The plant at Watson has skimming capacity of 70,000 barrels and cracking capacity of 10,000 barrels daily.

During the first quarter of 1928 Richfield distributed 27,653,458 gallons of gasoline and the Pan American companies, including properties operated under the name of Petroleum Securities Company, distributed 8,998,564 gallons. Only the Standard Oil Company of California and the Shell Company of California have distribution in California exceeding the combined Richfield and Pan American output.

The natural gasoline capacity of the Pan American and the Petroleum Securities companies totals 92,000 gallons from seven plants. Richfield will have this output in addition to its own production from 10 plants having a capacity of 97,500 gallons a day.

Through the merger, Richfield also acquires physical properties of the Pacific Petroleum Products Company, including marine terminals and distributing facilities on San Francisco Bay.

### REFINERY IN WEST INDIES

Construction work has been started by the Lago Oil & Transport Corporation on its 65,000-barrel capacity topping plant on Aruba Island, Dutch West Indies. The Lago corporation is a subsidiary of the Pan-American Petroleum & Transport Company, which in turn is controlled by the Standard Oil Company of Indiana.

Heretofore the Lago Company has confined its operations to producing crude oil, sending it to Pan-American's refineries in the United States and Mexico. The new refinery, which will be in operation early in 1929, will operate on the company's Venezuela production. There is one other refinery at present on Aruba Island, a 20,000-barrel plant of the Mexican Eagle Oil Company.

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### COMBINATION PLANT

Tulsa.—Independent Oil & Gas Company plans to build a combination natural gasoline and gas lift plant in the South Little River field—its second plant in the Seminole area. The output of the proposed new gasoline plant will be 25,000 gallons daily. It will be in the southeast of the northwest of Section 23-7-6, in a central position with respect to the company's properties in that area. The plant will include 10 compressor units, and will supply gas to the company's field operations.

### INSTALL JENKINS UNITS

Los Angeles.—Two Jenkins cracking units will be installed at the Vernon plant of the Hercules Gasoline Company, and one will be installed by the Rio Grande Oil Company at its Vinvale refinery near Los Angeles. Western Oil & Refining Company is installing its second Jenkins unit at its Wilmington plant, the first having been in operation several months.

### MODIFY EQUIPMENT

Tulsa.—C. H. Lebow's natural gasoline plant near Drumright, Oklahoma, in Section 8-17-7, is being changed from a compression unit to a combination compression and oil absorption unit, and when the change is made, it will have a capacity of 3500 gallons daily. R. O. Neal of Tulsa has charge of the plant construction and will operate it when completed.

*One of our spray nozzle cooling systems in operation at an oil refinery in Louisiana*

# An Investment Problem

**IF YOU need water cooling equipment at your plant, your problem is not merely one of buying equipment. Instead, it is a problem in investment—how to get the greatest return per dollar expended.**

**If you invest your money in one of our cooling towers or spray nozzle systems, we guarantee to give you the maximum return on your expenditure. We have made installations in plants where the available funds were limited, and also in plants requiring all the refinements necessary to secure the maximum operating economies. In every case we worked closely with their engineers in designing and adapting our standard equipment to meet their peculiar requirements.**

**A letter to our nearest office will bring to see you an engineer of experience, a man who is interested in helping you with your water cooling problem, a man who will consider that problem as one in investment in plant equipment.**

## THE COOLING TOWER COMPANY, Inc.

**15 JOHN STREET NEW YORK**

*Local Representatives:*

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The J. A. Rossiter Co.,
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Tulsa, Okla.,
N. M. Muir,
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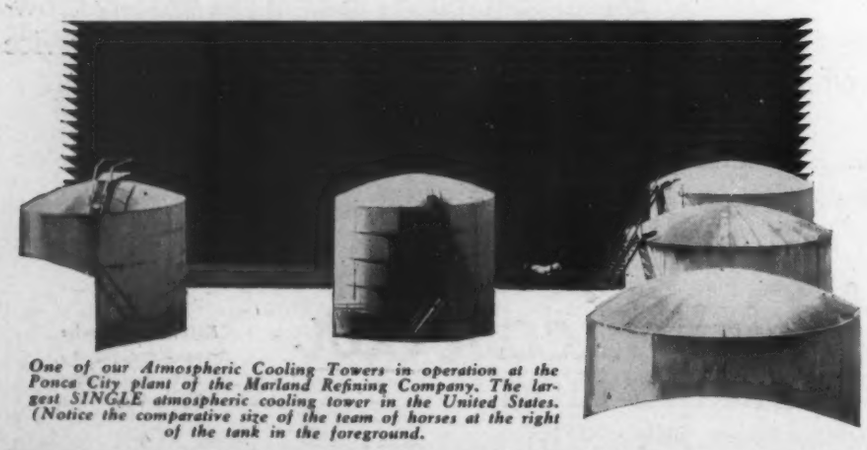
Los Angeles, Calif.
N. O. Fleming Co.,
5815 Maywood Ave.,
Huntington Park

*Representatives in Other Principal Cities*



*One of our Atmospheric Cooling Towers in operation at the Ponce City plant of the Marland Refining Company. The largest SINGLE atmospheric cooling tower in the United States. (Notice the comparative size of the team of horses at the right of the tank in the foreground.*


### INDEPENDENT-MANHATTAN MERGER

Tulsa.—The Independent Oil & Gas Company was negotiating the latter part of June for the purchase of the Manhattan Oil Company of Kansas City.

The Independent has a 5000-barrel refinery at Okmulgee with very limited distributing facilities, while the present distribution of the Manhattan company exceeds the refinery output. Manhattan owns and operates a refinery at Kansas City, Kansas, its output there being around 5000 barrels a day.

The Independent refinery at Okmulgee has skimming and cracking units and manufactures bright stocks, and several improvements are now being made, including the installation of a 5000-barrel pipe still unit.

### CAMDEN PLANT RESUMES

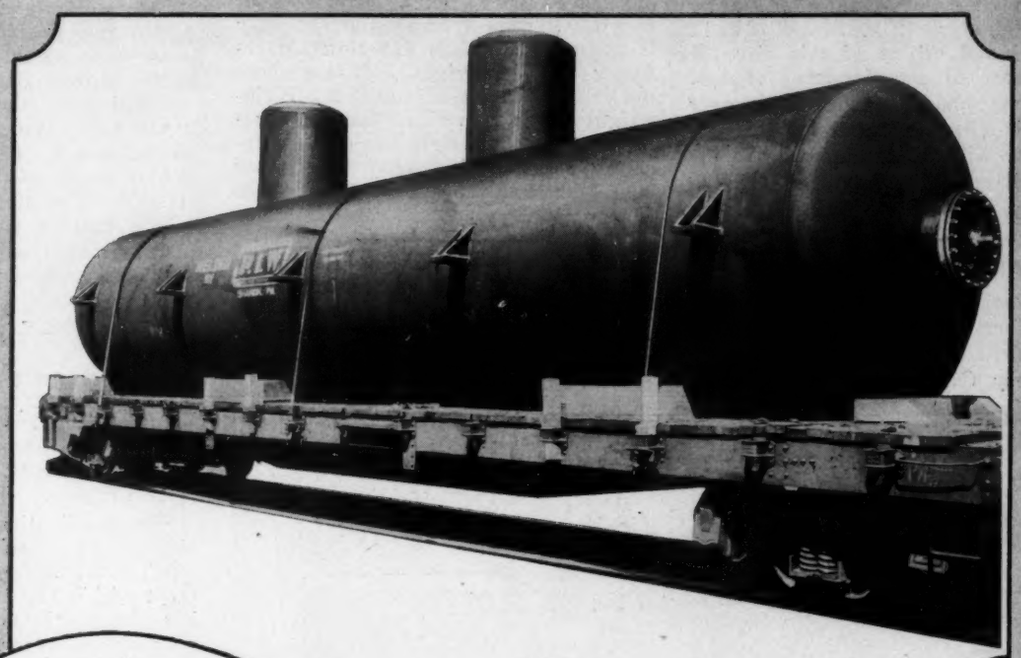
Shreveport, Louisiana.—The Houston Oil Company plans to resume operation of its refinery at Camden, Arkansas, about July 15. The plant has been shut down for over a year. Smackover and Champagnolle crude will be run through the present skimming and cracking equipment. The company is also installing a new pipe still of 3500 barrels daily capacity, and extending its 10-inch Norphlet-Camden line from Norphlet to the Champagnolle field. The new still will not be in operation, however, until fall. Meanwhile the capacity of the plant is about 3000 barrels daily.

### NUEVO LAREDO REFINERY

Laredo, Texas.—A 1500 barrel refinery is being built at Nuevo Laredo, Mexico, across the Rio Grande River from here, by the Cautemoc Refining Company, using material from the dismantled refinery at Cisco, Texas. It is expected to be in operation in August, and will use crude from the Mirando field, in addition to oil brought in by tank car from West Texas and the Gulf Coast.

Officers of the company include: Romeo Laurel, Laredo, president; E. M. Corch, San Antonio, vice-president; R. P. Lightfoot, San Antonio, secretary, and D. G. Gutierez, Laredo, treasurer.

Tidioute, Pennsylvania.—Controlling interest in the Tidioute Refining Company has been purchased by the Empire Oil Works, Inc., and the latter will take over the management of Tidioute's 1000-barrel plant here. Although the Tidioute Refining Company will continue to operate under the same name, there will be a change in the directorate, with A. L. Confer, also head of the Empire, president; W. Chase, vice-president, and H. R. Hawley, secretary and treasurer.



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FLUID-FUSION

## —for the advance of Petroleum Refining.

The progress of petroleum refining has always depended on the ability of the still and equipment manufacturers to adapt their fabricating methods to the production of equipment to meet every increasing pressure and temperature demands. But the distinct restrictions imposed by riveting and ordinary welding fabrication tied the manufacturers hands and seriously retarded refining advance.

Now these restrictions are removed and P. I. W. offers Fluid-Fusion welded cracking stills and equipment in wall thickness up to 6 inches and in dimensions to tax transportation limits.

The combination of Fluid-Fusion, automatic machine welding and the great P. I. W. plate fabricating facilities results in the production of stills and cracking equipment to resist pressure, temperature, and corrosion to a degree inconceivable with other types of equipment.

BRANCH PLANT — BEAUMONT, TEXAS.

THE PETROLEUM IRON WORKS COMPANY

NEW YORK CHICAGO SHARON, PA. HOUSTON TULSA

### ARKANSAS ASPHALT PLANT

El Dorado, Arkansas.—The Union Asphalt Company, capitalized at $10,000, was recently organized here by J. K. Mahoney, J. B. Sowell, H. L. Williford and others of this city for the purpose of manufacturing asphalt and heavy road oils from Smackover heavy oil. Raw material for the Union plant will be obtained from the nearby plant of the Lion Oil Refining Company.

### CANADIAN REFINERY

Chatham, Ontario.—Operations of the Absher Syndicate in the Wainwright field have been taken over by the Gypsy Oil Company, a Canadian incorporation. Management, however, will be in the same hands.

Using equipment designed by J. O. Absher to meet the requirements of the heavy crudes there, the company is operating a small experimental refinery at Wainwright. Through the use of this process, it is said, the Wainwright crude is refined into the following: gasoline, eight per cent., kerosene, 10 per cent., Diesel oil, 20 per cent., lubricants, 35 per cent., asphalt, 27 per cent.

Los Angeles.—MacMillan Petroleum Products Company's refinery at Signal Hill has been enlarged. The newly completed addition increases the plant's capacity 2500 barrels, making it 6500 barrels daily.

Texas Clay Products Co.,
Malakoff, Texas

Acme Brick Company,
Ft. Worth, Texas

# Texas fire brick

Athens Brick & Tile Co.,
Athens, Texas

Elgin Butler Brick Co.,
Austin, Texas

*High Grade Brick With Economy*

**QUALITY—** so high as to meet 85 per cent of fire brick users' needs, including cracking, pipe and shell stills as well as other needs of refiners.

**LOWER NET COST—** a product of the Southwest; Southwestern Refiners eliminate long-haul transportation. You get a high quality fire brick at a lower net cost than that of inferior brick coming from more distant points.

*Tell Us Your Needs—We'll Give You the Figures.*

*Write Any Office Below*

**TEXAS FIRE BRICK MFGRS. ASS'N**

Promoting Texas Fire Brick Economies

Texas Clay Products Co., Malakoff, Texas
Acme Brick Company, Fort Worth, Texas
Athens Brick & Tile Co., Athens, Texas
Elgin Butler Brick Co., Austin, Texas


### TWO GASOLINE PLANTS

Los Angeles.—The Standard Gasoline Company of California is building a new gasoline plant at Signal Hill and one in the Potrero field near Inglewood. The Signal Hill plant will have 20,000 gallons daily capacity. It is expected to be completed early in July. It will be equipped with five Rathbun-Jones engines. This will make a total of four plants of this company at Signal Hill. The other new plant will be in the eastern part of the town of Inglewood. It will have a capacity of about 500 gallons a day.

## New Refining Process

### ROSCOE C. KIRWIN

Patent has been granted to Roscoe C. Kirwin, Corapolis, Pennsylvania, for an apparatus for treating hydrocarbon liquids.

The combination consists of a crude oil still and a condenser, a conduit connecting the same, and a heating element within the condenser. The heating element is provided with a non-corrosive cover. The heating element is also provided with a copper cover and a confining wall of non-corrosive metal surrounding the heating element, but spaced with respect thereto to permit passage of vapor between.

The heating element within the conduit is surrounded by a jacket and spaced from the inner wall of the conduit, the jacket serving to protect the heating element against contact of the vapors from the still.

The heating element inserted in the conduit from the still to the condenser is energized by an electric current, with thermostatic control, thus regulating the temperature of the elements. Sufficient temperature is applied to effect cracking of hydrocarbons in vapor phase, without the application of pressure. It is claimed that no carbon is formed in the cracking of hydrocarbons by this process.

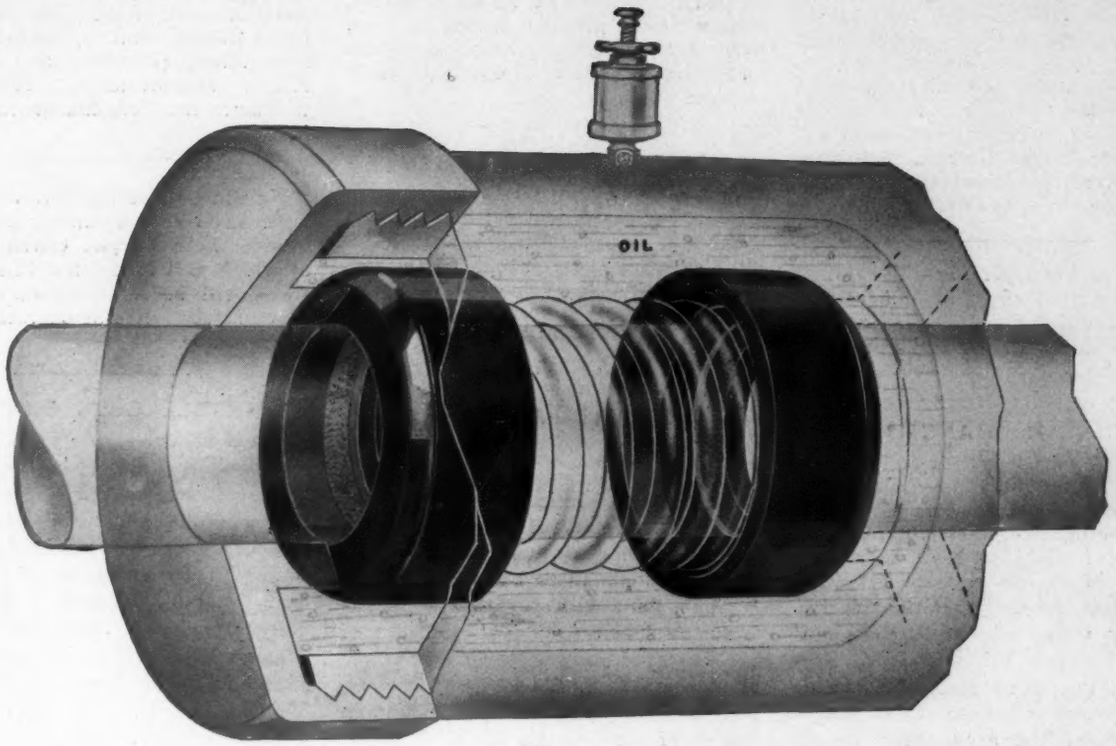
Further information may be had by writing the inventor.

### RESUME OPERATIONS

Fort Worth.—After being idle during the winter, the natural gasoline plant of the Continental Oil Company at Rattlesnake, New Mexico, has resumed operation.

Los Angeles.—Work has been started on the second unit of the Gilmore-Dabney Gasoline Company's gasoline absorption plant at Signal Hill, and the new unit is expected to be in operation by the latter part of July. It will have about 30,000 gallons daily capacity. The first unit is in operation, and although the output has not reached that mark yet, the unit is expected to be handling around 30,000 gallons of gasoline a day within a short time.

# Look who's using Cooke and then take a straight tip




STANDARD of New Jersey, Standard of Indiana and of California, Shell, Sinclair, Sun and many others—when their engineers buy Cooke Seal Ring because they know it eliminates pump and compressor packing leaks, *you* should know about it too.

This simple device, comprising but four major parts, does away with pump-leaks, abolishes scoring, reduces motor load, eliminates 90% of packing friction.

The Cooke Seal Ring is a simple mechanical device, correct in engineering principles, and perfect in performance. It is bound leak-proof and frictionally tight *on* and rotates *with* the shaft, instead of pressing against it, thus it forms a leak-proof contact against the gland—a ground joint.

Without renewals, maintenance, or service except for oiling, Cooke Seal Rings have been giving perfect service on constant duty machinery for as long as six years without appreciable wear.

Engineers and others interested in problems of maintaining pressure or preventing leaks around a revolving shaft will be very much interested in our booklet. The coupon below will bring one to you without obligation.

Mail it today.

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## 44 NORTH GREEN STREET, Dept. D, CHICAGO, ILLINOIS

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Please send me your FREE booklet without obligation.

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### SUN EXPANDS AT TOLEDO

Toledo.—The Sun Oil Company plans to erect storage tanks on a portion of the recently acquired 68-acre tract of land adjoining its refinery in East Toledo, and a large expansion of business here has been mapped out. At a cost of one million dollars, the refinery has been remodeled and enlarged from 6000 to 12,000 barrels capacity; and to increase marketing facilities large purchases of filling stations have been made, among the most important being those in the Detroit, Michigan, territory formerly operated under the name of the Greenslade Oil Company.

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Oil City, Pennsylvania.—The lubricating oil output of its plant here will be increased by the Independent Refining Company through the installation of new still equipment.

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### INDIAN CHANGES

Chicago.—Through a reorganization of duties in the Indian Refining Company plant at Lawrenceville, Illinois, B. H. Anglin, vice-president, formerly in charge of sales, has been made vice-president in charge of manufacturing; A. H. White, formerly assistant to Mr. Anglin, is vice-president in charge of sales, and Frank Fritts, a third vice-president, has been placed in charge of finances and corporate affairs. Henry W. Ralph of the accounting department has resigned and will establish himself as a petroleum accountant with offices in Chicago.

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Amarillo, Texas.—The new natural gasoline plant which the Canadian River Gas Company is building at Bivins, Texas, on the gas line extending from here to Denver, is nearing completion and is expected to be in operation early in July.

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### SKELLY GASOLINE PLANT

Tulsa.—Skelly Oil Company is building its first gasoline plant in the Seminole area: a plant which will be a combination natural gasoline plant and gas lift unit. It is located near the Earlsboro pool, and will have a capacity of three million feet of gas a day, and an output of 6000 gallons daily. The plant is so designed that it may conveniently be enlarged if desired.

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Chicago.—Operation of the Hosston, Louisiana, refinery of the Bayou State Refining Company, which has offices here, is scheduled to begin about July 1. The plant will specialize in manufacturing lubricating oils. Officers of the company include C. C. Longman, president; W. P. Elder, vice-president, and William Jervise, vice-president, in charge of the Chicago office.

### NEW NEW ORLEANS PLANT

New Orleans.—The recently organized White Oil Company of this city plans to build a topping plant on the Mississippi River south of here, and has already made contracts for crude oil supply and arrangements for disposal of some of the plant output. Officers of the company include J. Steffens White, president, and Dr. P. J. Kahle, vice-president. Headquarters will be in the Pere Marquette Building here.

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Houston.—Humble Oil & Refining Company's new skimming plant at Ingleside, near Corpus Christi, capacity of which will be around 12,000 barrels daily, will be in operation about the first of July. It will operate on West Texas crude.

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### CAMPBELL GETS CONTRACTS

Los Angeles.—J. A. Campbell, natural gasoline engineer, has been awarded contracts for the construction of two gasoline plants in Long Beach. One of them will be built for the Gilmore Oil Company on Linden Street near Columbia Avenue; it will have a daily capacity of 30,000 gallons. The other will be on the property of the Bankline Oil Company at Willow and Temple Streets, and will have 20,000 gallons capacity.

*Refinery Walkway (Type A)*

ARROWHEAD GRATING AND TREADS
For the Oil Industry

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Type A—For Walkways.
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Strong—non-slippable—well-appearing.

ARROWHEAD TREADS

The heavy nosing bar defines front.
The non-slip quality makes them safe.
They bolt direct to stringers.

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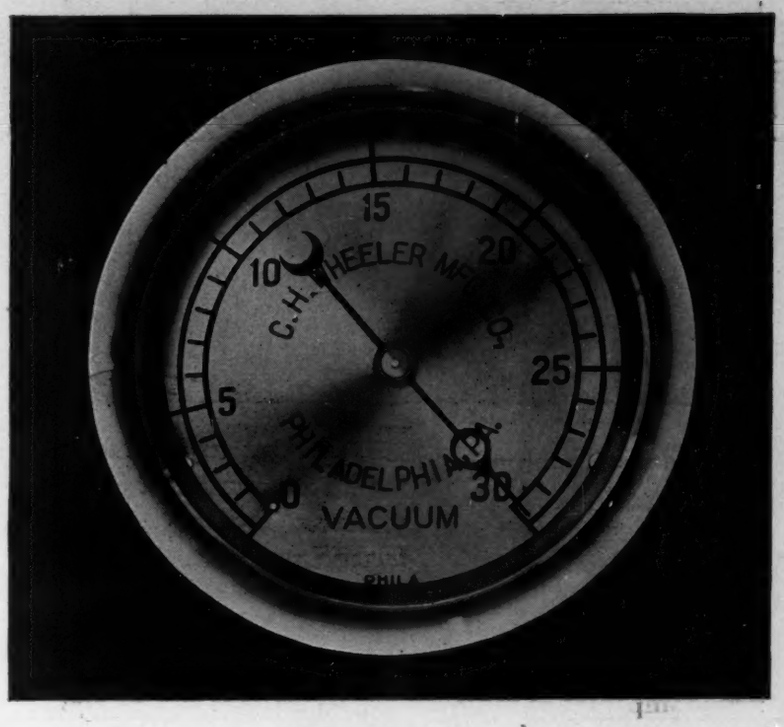
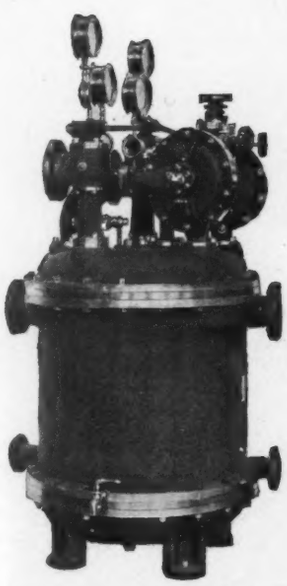



# Vacuum Approaching the Theoretical



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***We also manufacture:***

**Surface, Jet and Barometric Condensers; Leach Fracto Condensers; Oil Vapor Condensers for High Vacuum Distillation; Heat Exchangers; Forced and Natural Draft Cooling Towers.**

**An absolute pressure of O.m.m., the theoretical perfect vacuum, still lies beyond the boundary line between theory and practice; it is as unattainable as infinity.**

**The RADOJET Air Pump, developed by C. H. Wheeler engineers, approaches this condition of entire absence of pressure to a degree as economically practical as is possible. RADOJETS have been in operation for years, maintaining 3 m. m. Hg. absolute pressure, doing it consistently and dependably with a minimum of attention and upkeep cost.**

**The RADOJET, the highest development in steam air ejectors, is furnished in single or multi-stages, depending upon the degree of vacuum required. It has been successfully employed in every field employing vacuum in any of its processes.**

**Our engineers are pioneers in the development of this type of equipment. Let us send a booklet illustrating and describing the application of all types of the RADOJET, or, if your particular requirements are unusual, ask us for specific information.**

## C. H. WHEELER MFG. COMPANY

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**Philadelphia**

# C. H. WHEELER *of* PHILADELPHIA

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# PIPE BENDS *for refineries*

**Power Piping**
FOR EVERY INDUSTRIAL NEED

**THE many complex needs for piping required by the processes involved in refining make pipe bends a subject for much thought and study to insure economy as well as efficiency! We collaborate with many prominent companies to meet their specifications accurately!**

**Whether it's a plant or a fitting, put it up to "Power Piping"**

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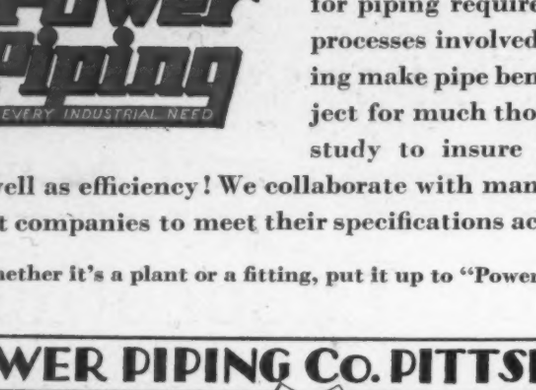
**POWER PIPING CO. PITTSBURGH**



**For cracking process in oil refineries we furnish Aluminum Armored Asbestos filled Gaskets and Corrugated Armco Iron or Monel Metal Asbestos encased.**

**Copper rings 3/16" thick for 4 and 5" O. D. tubing.**

**Washers or gaskets made of Aluminum, Copper and other Metals.**

*Write for Prices.*

# METALLO GASKET CO.

**NEW BRUNSWICK, N. J.**


## SKELLY "BOTTLES" GAS

Tulsa.—The Skelly Oil Company is now manufacturing and marketing a "bottled gas" to be used as a domestic fuel in places where natural gasoline and artificial gas are not available; and for the handling of this product, Skelgas, a special division has been formed. F. A. Pielsticker, vice-president in charge of the refining and marketing divisions of the Skelly Oil Company, is now in charge of the Skelgas division. E. S. Barber has been made sales manager of the division; and G. A. R. Slocum, sales manager of the company's refinery, will also be connected with the work of the Skelgas division.

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Wickett, Texas.—The Wickett Refining Company began operating its 2000-barrel skimming plant June 18. This plant is running tops purchased from the Blue Bonnett Oil Refining Company, which is located on an adjoining site near Wickett. The latter plant is supplied with crude on contract from the Hendrick field by the Southern Crude Oil Purchasing Company. Jack F. Reardon is superintendent of the Wickett Refining Company's plant, and sales are handled by the Dallas office of the company in the Magnolia Building.

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## LAREDO COMPANY EXPANDS

Laredo, Texas.—Capital stock of the Texas-Mexican Oil & Refining Company was recently increased from $150,000 to $250,000; and orders have already been placed for additional equipment for the enlarged plant. At the same meeting at which the stock was increased, the stockholders elected the following as directors: M. T. Cogley, president; C. R. Cole, chairman of the board; G. A. Mattson, vice-president; E. B. Brewster, secretary and treasurer; F. A. Lattig, M. M. Leyendecker and Dudley A. Tyng.

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Casper, Wyoming.—Wyomont Producing & Refining Company is installing a gasoline skimming plant in the Big Muddy field in Converse County. It will operate with a new type of pressure still which is expected to have considerable influence on the refining industry. The new plant will have a capacity of handling about 100 barrels of crude per day and the output will be sold locally.

---

## ENLARGE PLANT

Long Beach, Calif.—Capacity of the Lomita Gasoline Company's natural gasoline plant here will be increased through the erection of a new unit on a lot adjoining the present plant. It will be operated in conjunction with the present plant, but is so designed as to be able to operate independently. A newly designed absorber will be used in the new plant.

### PORTABLE PLANT STARTS

Midland, Texas.—The Midland Refining Company has started operating its portable plant here, having moved it to its present location from Wortham, Texas. Its operation here was started June 15, less than a month after it was moved from Wortham. In its location here it is handling daily about 1500 barrels of Winkler County crude oil obtained from the Atlantic Oil Producing Company.

Officers of the Midland Refining Company include T. W. Sowell of Dallas, president, and V. E. Jackson, vice-president, in charge of plant operations and sales.

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Toledo.—The Sun Oil Company has bought 68 acres of land here adjacent to its refinery, making possible the enlargement of the plant.

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Amarillo, Texas.—Following the establishment here of distributing division offices by the Phillips Petroleum Company, Lawrence Locke has been transferred to the Amarillo offices from the Bartlesville, Oklahoma, offices.

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### N. P. A. MEETING

Washington.—Annual meeting of the National Petroleum Association will be in Atlantic City at the Hotel Traymore on September 19, 20 and 21, according to F. B. Dow, general counsel.

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Tulsa.—The refining plant of the White Oak Refining Company, near Allen, has been bought by the Gulf States Terminal & Transport Company of Tulsa. The property includes a 2500-barrel skimming plant and a 25-mile pipe line into the Seminole area. Victor H. Smith is president of the refining company, as well as the Gulf States organization. Other officials are Louis W. Pratt, vice-president; B. E. Conner, secretary; Walter G. Johnson, sales manager, and A. M. Smith, plant superintendent.

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### COSDEN TO BUILD LINE

Chicago.—J. S. Cosden, who recently purchased production in Howard County, Texas, said here recently that work on his proposed pipe line from the location of that production to Sweetwater, Texas, will be started within a short time. The line will supply a 5000-barrel refinery for which W. D. Richardson has announced plans, and later a 10,000-barrel plant to be built by Mr. Cosden and associates.

---

### MOVE GASOLINE PLANT

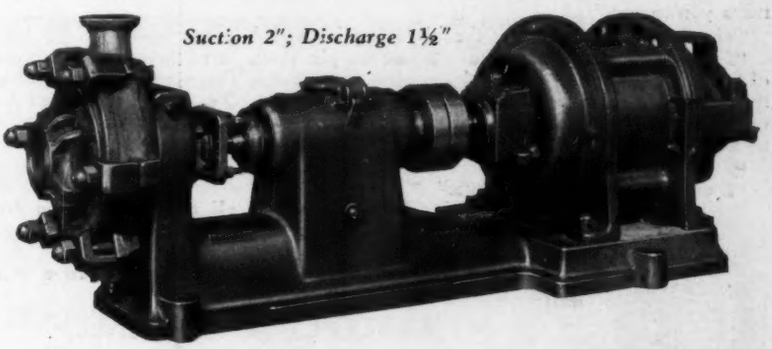
Casper, Wyo.—The New York Oil Company's natural gasoline plant at Riverton will be moved to Sand Draw in Freemont County, and will have a capacity of 2,000 gallons daily there.


# Saving Money Pumping Acid

WITH an installation cost lower than any other type of acid handling equipment, a Duriron pump will handle your acid with less power, time and labor than with air. A Duriron pump also eliminates the danger of tank rupture by excessive air pressure.

Maintenance expense is practically nil as all parts of this sterling unit coming in contact with the acid or sludge are extremely resistant to the dual attack of corrosion and erosion encountered in refinery service.

These pumps are produced in size from a 2" suction by 1½" discharge to 10" suction by 8" discharge. Complete information mailed on request.

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SPECIFY Kerlow Gratings and Safety Steps For:

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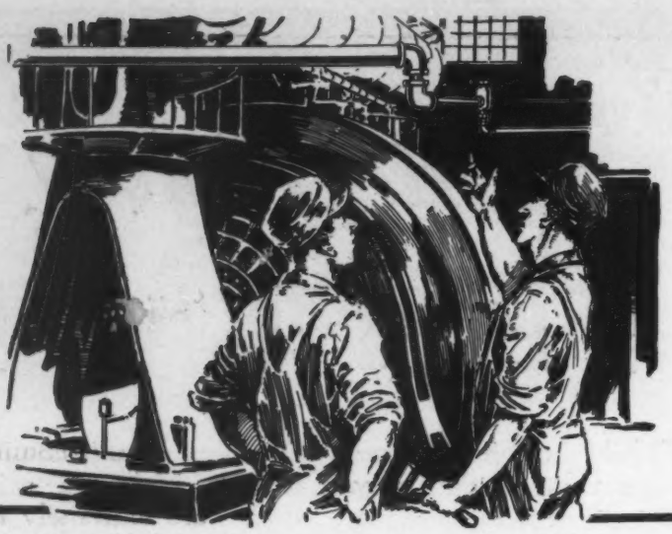


# "That's why our fuel bills are less than yours!"

"Let me tell you, old man, I've learned more about the fuel wasting power of condensate since we installed Sarco Steam Traps than I ever knew before."

"Do you see how that *Sarco Trap* screws into the pipe line? Didn't have to bother to dig a pit or build a platform. I didn't even have to adjust it, for it's self-adjusting from 0 to 100 lbs."

"And notice the size."

"I'll bet it isn't a quarter as big as yours."

"It has no bucket, float, levers, etc. Just one moving part."

"Now then, Pete, my boy, what do you think that trap cost?"

"I don't know. Maybe $20.00 or $30.00—how much?".

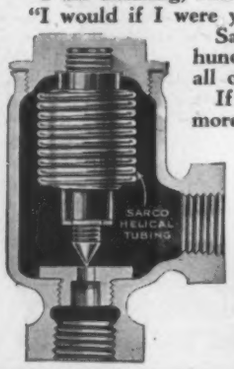
"Only $9.00. That's about one-third the price of those big, old-fashioned traps you've got."

"That's all very fine. But the big thing is—are they any good?"

"I was coming to that, Pete. When we put them in we kept careful record of coal consumed and do you know that those Sarco Traps paid for themselves in less than a month by cutting down our coal bills. Yes, sir. And here's another thing. Every shovelful of coal we save means a shovelful we don't have to shovel. Think about that!"

"I am thinking, Harry!"

"I would if I were you, Pete."




Sarco Steam Traps are saving all the way from a few hundred dollars up to thousands of dollars a year in plants all over the country.

If this is interesting, our booklet S-284 will prove even more so. Copy sent upon request.

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183 MADISON AVE., NEW YORK CITY

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**SARCO STEAM TRAP**

# The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

*Samples on request.*

**B. MIFFLIN HOOD BRICK CO., Atlanta, Ga.**

## MOVES PLANT

Shreveport, La.—The Ohio Oil Company is moving its absorption type natural gasoline plant from the Pine Island field to the Cotton Valley field, and will enlarge it in its new location.

## BARNSDALL DOUBLE OUTPUT

Tulsa.—With the addition of a 28,000-gallon plant in the Earlsboro field, Oklahoma, the Barnsdall Oil Company now has eight natural gasoline plants in Oklahoma and one in Kansas which have a combined daily capacity of 55,100 gallons, or about double the capacity of the company's gasoline plants a year earlier.

## IMPROVE KANSAS REFINERY

Coffeyville, Kan.—At a cost of about one-half million dollars, the National Refining Company will improve its refinery here. A battery of high pressure stills will replace those now in use, and the capacity of the renovated plant will be 7500 barrels daily.

## PANHANDLE MOVES

Wichita Falls, Texas.—The Panhandle Refining Company has moved its general offices from the Staley Building to the new Panhandle Building, a four-story building, in which it owns a one-half interest, and will occupy the third and fourth floors.

## SHUT DOWN REFINERY

Tulsa.—The Riley Petroleum Company has shut down for an indefinite period the skimming plant which it has operated under lease for the past three years, and which is owned by the Wilcox Oil & Gas Company of Tulsa.

## ELLIOTT OFFICE CHANGES

Elliott Company, Jeanette and Pittsburgh, Pennsylvania, announces the opening of a new district office in Denver, Colorado, at 512 Mining Exchange Building. M. C. Sickels, formerly district manager in Cleveland and Chicago, is in charge of the new office.

F. A. Calmus, for the past two years district manager of Elliott Company's Kansas City office, has been transferred to San Francisco where he will open up a new sales office. Mr. Calmus has been in the Kansas City territory for Elliott Company for the past seven years.

W. E. Widau will take up Mr. Calmus' duties as manager of the Kansas City district. Mr. Widau for the past several years has been located in Elliott Company's main office in Jeannette as condenser department sales manager.

Chatham, Ontario. — Imperial Oil, Limited, plans to establish a new plant in Regina, Saskatchewan, for the manufacture of asphalt.

1 2 3 4 5 6

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# Abstracts of Technical Literature

## *Of Particular Interest to the Plant Operator*

### Refining

*Neutralizing Naphthenic Oils and Dry-Refining by a New Process. Leemans.* (*Petroleum, May* 1, 1928, *p.* 549; *Libr. Bull., U. O. P. Co., Vol.* 3, *No.* 20.) A Mid-Continent oil gave difficulty in refining and the original crude was found to have an acid number of 5 or 6. Sodium carbonate and hydroxide would not neutralize the acidity, but slaked lime accomplished this completely by keeping the oil, at 40 degrees-100 degrees C. (104 degrees-212 degrees F.), in motion for several hours. The process can be controlled by taking 100 cc. samples, distilling off 10 cc., and titrating in neutral alcohol-ether mixture with normal soda solution.

Very small amounts of calcium carbonate and sand may be added with the lime, and the oil should then be allowed to stand before distilling. If the oil is not cracked in distilling, the calcium naphthenates enter into the asphalt in this form. The asphalt containing lime with the same penetration and the same softening point as asphalt without it has the same ductility, but the thread drawn out soon drops down; while the asphalt without the lime remains stretched. The lime also renders it difficult to form emulsions from the asphalt with most emulsifying agents. This is no disadvantage, however, in the use of the asphalt for paving. The naphthenic acids are neutralized and inactive, and the asphalt is the more resistant to water. The crude oil was estimated to contain about 10 per cent. of naphthenic acids.

The oil treated with lime had too high a cold point (— 2 degrees C. or 35.6 degrees F.), a disagreeable smell, and a dark color. It was found that the tar could be agglomerated by adding sodium silicate in the proportion of 30 litres of 40 degrees Be. solution to 6000 litres of oil, stirring with air and then adding 10 litres more of the silicate. The acid tar sank quickly to the bottom and was drawn off, and the oil was transferred to shallow pans to finish settling, during which process it was an advantage to warm it, reducing the viscosity. It passed from there to the bleacher, where it was warmed to 100 degrees C. and treated with 1 or 2 per cent. of powdery slaked lime and then to the filter press.

The lubricating oil refined by this process is orange yellow to yellow. The only loss of oil is in the acid treatment. Lubricating oil with a viscosity of 70 degrees E. at 50 degrees C. (122 degrees F.) required 2¼ per cent. of 66 degrees sulfuric acid; 8 degrees, 3 per cent; 10 degrees, 3¾ per cent. This process of refining raised the viscosity in the average about 4 per cent. Unlimed oil treated by this process contained four times as much ash, and emulsified readily. The process corrected the odor of the oil and lowered the cold point to—6 degrees C. (12.2 degrees F.).

* * *

### Distillation

*Distillation of Oil Products in a Stream of Different Gases. Chernoshukov.* (*Neftyanoye Khozyaistvo* 13, 63-5 (1927). *C. A., Vol.* 22, *No.* 10, *pp.* 1845-46). A 500 cc. cylindrical, graduated separatory funnel was used as a carburetor. The funnel contained a layer of chipped porcelain and a layer of copper shavings. A glass tube inserted through the top opening reached nearly to the bottom. Temperatures of the gas and the liquid were measured. Into the funnel was introduced exactly 75 grams of the liquid to be tested. This apparatus was kept in a thermostat at exactly 20 degrees C. The gas was led through a spiral immersed in the same thermostat. A gasometer was used to measure the amount of gas used for the experiment. Hydrogen, carbon dioxide, nitrogen and air were taken as carriers of vapor. Gasolines from Baku and from Groznui with a boiling range of 100 degrees-150 degrees C. were investigated. The nature of the gas does not affect the speed of vaporization.

* * *

### Fractional Distillation

*Modern Ideas in Fractional Distillation. Robinson.* (*Chem. and Ind., April* 20, 1928, *p.* 405. *Libr. Bull., U. O. P. Co., Vol.* 3, *Nos.* 21 *and* 22). The essential parts of a commercial intermittent still are the kettle from which the liquid is distilled, the rectifying column in which most of the separation takes place, and the condenser which condenses the vapors and furnishes the reflux for the column. In a continuous still the liquid to be fractionated is introduced into the central portion of the column and a steam supply as a source of heat at the bottom. The number of plates needed for separating the components of a binary mixture may be calculated by McCabe and Thiele's method (Ind. Eng. Chem. 17, 605 (1925) ). The number of plates required to effect a given degree of separation depends on the reflux ratio, that is, the ratio of liquid running down the column to the distillate. The higher this ratio the fewer the number of plates required.

The following generalizations are applicable to mixtures of any number of components:

I. The function of the portion of the rectifying column above the feed plate is to remove the less volatile constituents, leaving the distillate composed of only the more volatile fractions.

II. The portion of the column below the feed plate serves to separate the more volatile fractions from the stream of the heavier fractions leaving the bottom of the column.

III. Heat must be supplied in the lower part of the column either as the latent heat in rising vapor or as heat from steam; and must be withdrawn from the upper part, usually by condensing part of the distillate, which may be by means of cold feed, low-boiling feed, or downflowing feed. Any portion of the column below the point where heat is introduced and any portion above the portion from which heat is abstracted are inoperative.

IV. A single condenser at the top of a column with part of the condensate returned as reflux is more economical than more complicated condensing arrangements intended to give better rectification; unless the feed to the column is pre-heated by acting as cooling medium in the condensers.

V. The vapor velocity permissible is independent of the number of components in the mixture.

VI. In general, if sharp cuts are to be made there must be as many columns less one as there are products to be taken off. For separating crude petroleum sharply into gasoline, kerosene, gas oil, and fuel oil in a continuous still, three columns must be used.

Generalizations applicable to mixtures of any complexity:

Generalization IX.—When a partial condenser is used in the removal of a mixture of several components as the distillate, the outlet temperature of this condenser is always the condensing temperature of the distillate under the operating pressure, and is always intermediate between the initial and final boiling points of the distillate.

Nevertheless, such a system may be operated so that there is a sharp separation between the components of the feed at the point required, although the boiling points of the components with vapor overloads the column when the percentage of distillate in the feed is small, but may be very desirable when the percentage of distillate in the feed is large.

Generalization XII.—If the feed enters as liquid and a small percentage is removed as distillate, the main task of the column is to strip all the volatile constituents from the residue, which means that a large exhausting section is required. If most of the feed is taken off as distillate, the main problem is the removal of the traces of residue from the distillate, which requires a large column above the feed point.

* * *

### Cracking

*Cracking of Heavy Oils and Mazut. Sachanov and Tilitschejev.* (*Neftyanoe Chozjaistvo, U. S. S. R., March,* 1928, *pp.* 328-353; *Libr. Bull., U. O. P. Co., Vol.* 3, *No.* 20). Summary.

I. Three basic types of cracking were studied:

(a) Light cracking to obtain high grade (low viscosity) fuel oil.

(b) Medium cracking to obtain gasoline and fuel oil.

(c) Heavy cracking to obtain gasoline and coke.

II. A standard method of investigation was worked out:

(a) Temperature—425 degrees C. (797 degrees F.). The rate of cracking doubles itself with every 10 degrees C. (18 degrees F.) rise in temperature.

(b) Pressure—for light cracking—10 atmospheres. Pressure—for medium cracking—10-20 atmospheres. Pressure—for heavy cracking—60 atmospheres.

(c) Time element—from 10 minutes to several hours, depending on the type of cracking and charging stock.

III. The rate of formation of gasoline and kerosene in cracking was practically the same for all heavy oils and mazut tested.

At a temperature of 425 degrees C. there was formed in a 30-min. period—8-10 per cent. gasoline and 12-15 kerosene.

60-min. period—18-20 per cent. gasoline and 18-22 kerosene.

120-min. period—36-40 per cent. gasoline and 36-44 kerosene.

IV. The rate of formation of gasoline and kerosene depends on time and temperature, but not on pressure. 10-60 atmos.

V. The rate of coke formation depends greatly on the kind of charging stock used.

VI. Kind and quantity of coke formed corresponds to kind and quantity of gasoline made.

* * *

### Chemical Treatment

*Designing Equipment for Chemical Treatment of Oil Distillates. Part 2. Morrell and Bergman. (Chem. and Met. Eng., Vol. 35, No. 5, pp. 291-95).* Blow-cases are still commonly used in petroleum refineries for measuring and handling the sulfuric acid and caustic soda solutions used in the chemical treatment of oil distillates. In order to proportion the reagents when blow-cases are used under various differential pressures, several sizes of orifices must be used. To facilitate the design of these orifices, Morrell and Bergman have made the following calculations:

*Flow of Acid and Caustic Through Orifice*

Specific gravity of 66-deg. Be. acid..1.84
Specific gravity of 30-deg. Be. caustic soda .....1.26

From general orifice formula:

Q equals CAV 2GH.

Q equals quantity in cubic feet per second.

C equals co-efficient—approximately 0.61 for low ratio of diameter.

A equals area of orifice—square feet.

G equals gravity constant—32.2 feet per sec. per sec.

H equals pressure drop across orifice—feet of liquid.

Transferring pressures in pounds to head of liquid of the desired specific gravity, we have:

Acid—1 lb. per sq. in. equals 2.30-1.84, equals 1.25 ft. of acid.

Caustic—1 lb. per sq. in. equals 2.30-1.26, equals 1.825 ft. of caustic.

| Diameter of Orifice Inches | Area Sq.In. | Pressure—Lb. per Sq. In.—Q equals Pounds of Acid per Hour 4 | 20 | Q equals Gal. Caustic per Minute 4 | 20 |
|---|---|---|---|---|---|
| 1-16 | .0031 | 97 | 217 | .... | .... |
| 3-32 | .0069 | 216 | 483 | .... | .... |
| 1-8 | .0123 | 385 | 860 | .51 | 1.13 |
| 5-32 | .0192 | 600 | 1,344 | .79 | 1.77 |
| 3-16 | .0276 | 864 | 1,930 | 1.14 | 2.54 |
| 1-4 | .0491 | 1,540 | 3,440 | 2.02 | 4.54 |
| 5-16 | .0765 | 2,400 | 5,350 | 3.15 | 7.05 |
| 3-8 | .110 | 3,440 | 7,680 | 4.53 | 10.15 |
| 7-16 | .150 | 4,690 | 10,500 | 6.18 | 13.85 |

Charts are given showing the flow of 66-degree Be. sulfuric acid and 30-degree Be. caustic soda solution through orifices of various sizes, together with examples of the use of said charts.

Authors recommend that for good results the differential pressure across orifice be kept between 6 and 20 pounds; too low a pressure can cause large variations in the quantity flowing due to comparatively small fluctuation in the pressure; too large difference of pressure results in a small orifice, which is easily plugged or corroded to give a greater quantity than is desired. In designing blow-cases a safety factor of 8 is recommended instead of 5 on account of corrosion, or a rough rule for guidance is to allow ⅛ inch for corrosion. Blow-cases should be installed in duplicate and should be of a capacity sufficient to take care of a one-day or one-shift operation. Acid, caustic and plumbite pumps should have an approximate capacity of 10 barrels per hour with by-pass arrangements and should be of the positive piston, duplex or rotary type. Re-circulating pumps of the rotary gear or centrifugal types should have a capacity of approximately 20 barrels per hour, also with by-pass arrangement. Acid-resistant bronze or cast iron and steel pumps with liners will serve for both acid and alkali. Authors give numerous hints on design and functioning of settling tanks in a continuous-treating system.

Arrangement of a treating plant depends upon the particular order of treatment which, in turn, is dependent upon the type of distillate to be treated. Detailed methods for treating various types of cracked distillates are given. A system for the treatment of distillate for removing hydrogen sulfide is illustrated and described; also, of a pressure distillate washing and sweetening system and of a modified batch-treating system wherein circulation of oil and reagent is


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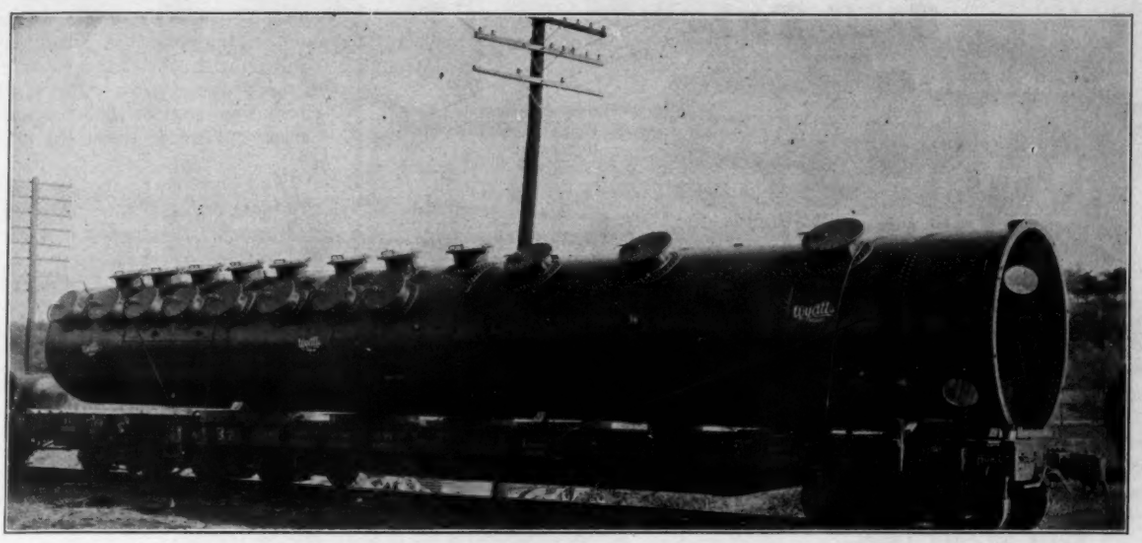

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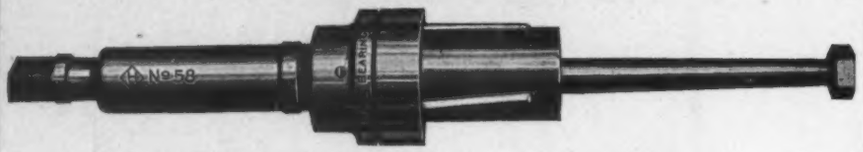


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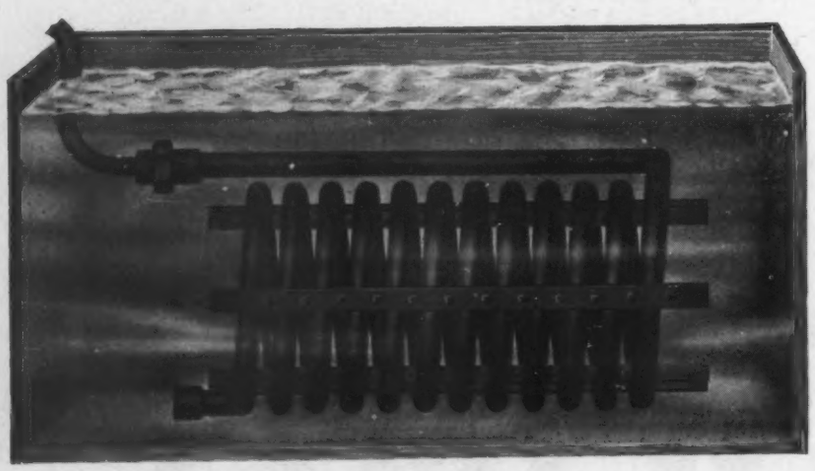

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provided. In the latter system a special feature—in addition to the circulating pump—is the arrangement for the separate draw-off in regulated proportions of oil and sludge to be recirculated. This provision permits mixing the reagent with the oil in any proportion in the pump. As an example of a batch-circulating system, the design of a 1000-barrel agitator is discussed in detail.

* * *

*The Continuous Treatment of Light Oil Products. Kechek.* (*Azerbeidyanskoye Neftyanoye Khozyaistvo,* 1927, *No.* 10, 77-82. *C. A., Vol.* 22, *No.* 10, *p.* 1845). Kechek objects to Emmuil's statement that the rate at which the oil passes through the acid is the same as that at which it passes above the acid. Kechek gives figures to show that the rate is different.

*Vol.* 22, *No.* 10, *p.* 1845). Kechek objects

* * *

## OF PARTICULAR INTEREST TO THE REFINERY AND CHEMICAL ENGINEER

### Fractionating Columns

*Design of Fractionating Columns. Keyes, Soukup and Nichols.* (*Ind. and Eng. Chem., May,* 1928, *p.* 464. *Libr. Bull., U. O. P. Co., Vol.* 3, *No.* 19.) The minimum number of plates required in a column for separating a binary liquid mixture into its components can be found practically by the graphical method described by McCabe and Thiele in Ind. and Eng. Chem. 17 605 (1925). A simplified form of this method is here described. A composition curve is plotted for a 50-50 benzene-toluene mixture for instance, in which $x$ represents the mol (or vol. or wt.) percentage of benzene in the liquid and $y$ the percentage of benzene in the vapor at the same level in the column. The equal-composition curve is drawn from zero to 100 per cent with a slope of 45 degrees. Vertical dotted lines are inserted at the percentage benzene of the feed, 50, at that of the product, 99, and at that of the residue, 1 per cent. From the points where the 1 per cent and 99 per cent verticals cut the equal-composition line the two parts of an enrichment curve are drawn, meeting at the 50 per cent point between the equilibrium curve and the equal-composition curve. Starting at the 99 per cent point on the former, a broken curve consisting of "steps" of horizontal and vertical lines is drawn, of which the lower series of points is in the enrichment curve, the upper, in the equilibrium curve. The number of these steps gives the theoretical minimum number of plates for the column, in this case 10. Multiplying this by the safety factor 2, learned from experience, gives 20 plates required in practice. McCabe and Thiele's figure, 13, for the same separation with a reflux ratio of 5:1, when divided by the plate of efficiencies 0.8 to 0.6 gives from 16 to 22 plates.

Separation of alcohol-water or acetic-acid-water mixtures requires a safety factor of 3; using this factor the results again agree with McCabe and Thiele's figures.

* * *

### Gasoline Flow in Pipes

*Gasoline Flow. Miller.* (*Chemiker-Zei-*

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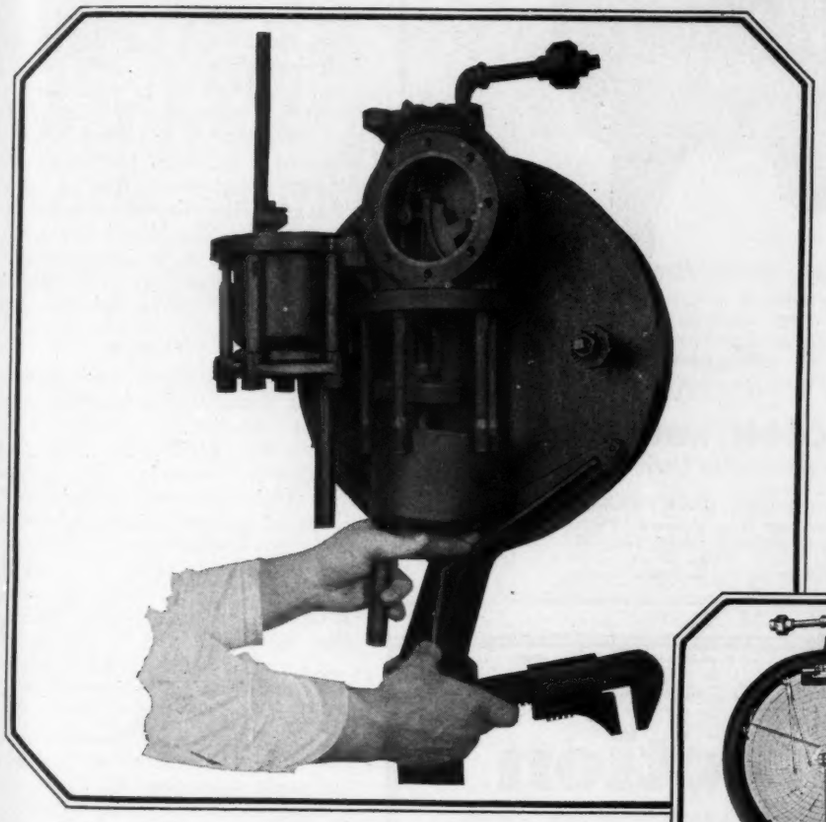

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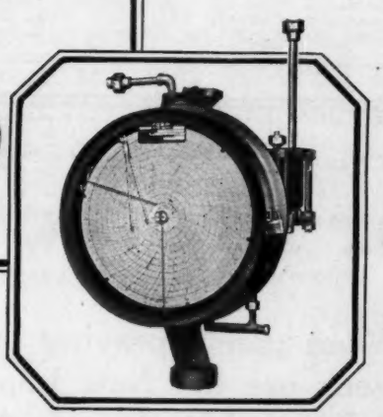

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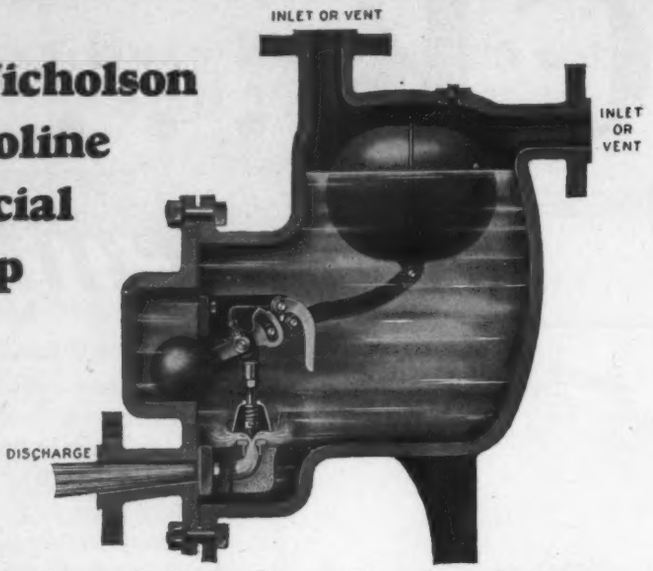


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*ting, April* 11, 1928, *pp.* 290-1). In a study of the rate of flow of gasoline through a vertical 5-meter pipe it was found that in 1-inch and ¾-inch pipe the flow is not much faster at the bottom than at the top and the rate of 4 meters per second, considered the maximum safe speed above which excessive charges of static electricity will be generated, was not attained. In ½-inch pipe this rate of flow was exceeded.

* * *

### Steam Flow in Pipes

*Measuring Steam Flow in Pipes by Means of Ring Diaphragms. Pflaum. (Forschungsargeiten auf dem Gebiete des Ingenieurwesens, No.* 298, 1928, *Mech. Eng., Vol.* 50, *No.* 6, *p.* 504). Report from mechanical laboratory of Danzig Institute of Technology on experiments for determination of discharge coefficient of steam flowing through orifices of pipe diaphragms, using ethylene bromide as pressure-indicating liquid and employing pressures from 3 to 11 atmospheres; compares with results of earlier experimenters, including Brandis, Spitzlass, Reschke, etc.

* * *

### Boiler Plant Operation

*Heat Transmission in Modern Boilers. Roszak and Vernon. (Power Engr., Vol.* 23, *No.* 265, *April,* 1928, *p.* 152). Discusses factors influencing heat transmission with special reference to their bearing on design of modern boilers and possibilities of further improvements; methods of increasing heat transfer by radiation and convection; typical data concerning heat absorption per unit area of heating surface under different conditions.

* * *

*Automatic Combustion Control. (Jl. Sci. Instruments, Vol.* 5, *No.* 1, *Jan.,* 1928, *pp.* 17-19. Instruments employed to control stokers, dampers and fans to obtain automatic operation of furnaces; four controllers, one actuated by steam pressure and other three controlling fuel feed, air flow and furnace pressure, respectively; master controller consists of pressure gauge with spring and weight control and contact arm with variable lever ratio moving over contacts of rheostat; three other controllers consist of differential pressure balances.

* * *

*Lime and Soda Treatment of Feed Water. Partridge. (Power, Vol.* 67, *No.* 12, *March* 20, 1928, *pp.* 507-09. Results obtained by use of lime-soda softeners; accompanying tables of analyses support statement that water may be made actually more corrosive in character by partial softening with lime and soda and that lime-soda softening does not insure formation of soft sludge in boiler unless treatment be complete.

* * *

## OF PARTICULAR INTEREST TO THE CHEMIST

### Testing and Analysis

*Determination of Water and Mud in Oil Products. Selskii. (Neftyanoe Khozyaistvo* 13, 623-31 (1927). *C. A. Vol.* 22, *No.* 9, *pp.* 1674-75.) In the distillation of gasoline there are formed 3 layers: water, water-gasoline emulsion and gasoline. The water is drawn off and the emulsion

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QUARTER TURN VALVES
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FOUR WAY
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ROUND OPENING REFINERY

PROTECTED SEAT VALVES
HYDRAULIC (B.O.PAT.) OPERATING
REMOTE CONTROL
GLOBE
ROSS AIR SHUT-OFF VALVE
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**This device controls steam flow to oil stills**

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***Bulletin on Request.***

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**The CAMPBELL ENGINEERING CO.**
**Shorts Hills, N. J.**

***Manufacturers of the TAR BABY BURNER, to handle Fuel Oils, Water Gas Tar, Acid Sludge, and Residue Fuels.***

**Without obligating us in any way, please send information on ( ) the Watermelon Type, ( ) the Pumpkin Seed Type, ( ) the Tar Baby Oil Burner.**

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broken up by shaking. The use of centrifuges is recommended for complete separation. For mud determination, centrifugation is advisable.

* * *

*Problems in the Analysis of Unsaturated Hydrocarbon Mixtures. Davis.* (*Paper presented before Petr. Div., A. C. S., St. Louis, Mo., April* 16-29, 1928. *Libr. Bull., U. O. P. Co., Vol.* 3, *No.* 18). This paper represents a search after scientific foundations for methods of analysis of the unsaturated constituents in hydrocarbon mixtures boiling below 50 degrees C. Broadly, the methods depend on two operations:

1. Separation of the hydrocarbons into boiling-point groups by fractionation.
2. Identification and estimation of the hydrocarbons in the boiling-point groups from studies of the relative rates of reaction of the pure substances with various reagents.

* * *

## RESULTS OF RESEARCH AND INVESTIGATIONAL WORK

*Solid-Solution Formation in Mixtures of Paraffin Waxes. Myers and Stegeman.* (*Ind. and Eng. Chem., Vol.* 20, *No.* 6, *pp.* 638-41). Authors report the results of an investigation dealing with the formation of solid solutions of paraffin waxes and the influence of this property on the separation of oil and wax. Their conclusions follow:

Distillation of paraffin wax shows that:

(a) Paraffin waxes from different sources have very similar compositions.

(b) Differences in the melting points of commercial paraffin waxes are due to differnces in their oil content.

Investigation of the wax mixtures shows that:

(a) That paraffin waxes form solid solutions.

(b) The melting points of the solid solutions lie between the melting points of the components.

(c) Owing to the existence of solid solutions, paraffin wax does not possess a sharp melting point.

The investigation of oil-wax mixtures leads to the following conclusions:

(a) The solubility of paraffin wax in oil increases very markedly at temperatures approximately 10 degrees C. below the melting point of the wax.

(b) The low-melting waxes are more soluble in oil than the high melting waxes.

(c Mixtures of high- and low-melting waxes have solubilities intermediate between the solubilities of the components.

(d) The increase in solubility of the mixtures in oil at temperatures approximately 10 degrees C. below their melting points is as marked as in the case of pure waxes.

(e) The marked increase in solubility explains the loss of wax in the later stages of the sweating process.

(f) Paraffin wax apparently retains oil as a solid solution of oil in wax.

(g) The wax retains approximately 2 per cent of oil at room temperature, but the amount retained at the temperature at which the final sweating is carried out is too small to be detected.

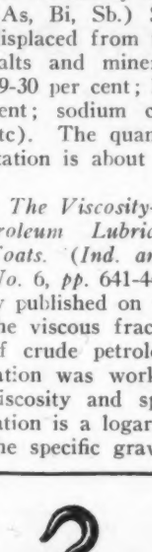
(h) The presence of this small small amount of oil in solution offers an explanation for some of the difficulties encountered in the separation of oil from wax.

* * *

*Some Properties of Sulfonic Acids from Petroleum Products. Dobryanskii and Anurov.* (*Neftyonoe Khozyaistvo* 13,200-4 (1927). *C. A. Vol.* 22, *No.* 9, *p.* 1674). Petroleum sulfonic acids are colloids. Being dry, they swell up in organic solvents forming gels. Salts of metals belonging to the first group are soluble in water, except the copper salt. Salts of metals from the second group (series Be, Zn, Cd, Hg) are soluble in hot water to an appreciable extent. No precipitates are formed by elements of the fifth group (As, Bi, Sb.) Sulfonic acids are easily displaced from their aqueous solution by salts and mineral acids (sulfuric acid, 29-30 per cent; hydrochloric acid, 8-9 per cent; sodium chloride, 14-15 per cent, etc). The quantity required for precipitation is about 5 mol. per cent.

* * *

*The Viscosity-Gravity Constant of Petroleum Lubricating Oils. Hill and Coats.* (*Ind. and Eng. Chem., Vol.* 20, *No.* 6, *pp.* 641-44). From data previously published on the physical properties of the viscous fractions from various types of crude petroleum, a mathematical relation was worked out between Saybolt viscosity and specific gravity. The relation is a logarithmic one and expresses the specific gravity in terms of the vis-

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**Sizes ¼, ½, 1 and 1½ Tons. A Quick Acting Hoist, Light Weight, Easily carried around.**

**The empty bottom hook can be raised to load by simply pulling slack of load chain.**

**It can be lowered to load by pulling cord, which releases ratchet, with the other hand pull hook down to load.**

**Pressed Steel Plate Construction. Heat Treated Cut Steel Gears. Solid Steel Suspension from hook to hook.**

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cosity and a constant which is different for each crude and is characteristic of it. This "viscosity-gravity constant" is low for the paraffinic crudes and high for the naphthenic crudes. Its value for any oil is a direct index of the degree of the paraffinic or naphthenic character which it possesses.

* * *

*Effect of Volatility of Petroleum Fractions on Detonation Value. Geniesse and Huf.* (*Paper presented before Petr. Div., A. C. S., St. Louis, Mo., April* 16-20, 1928. *Libr. Bull. U. O. P. Co., Vol.* 3, *No.* 18). The effect of volatility of petroleum fractions on detonation value was determined by testing fractions of different distillation ranges. Five naphthas, three straight run and two cracked, were cut into fractions by simple distillation. The originals, fractions and some blends of the latter were tested in a motor. The data, when plotted, show a useful relationship, making it possible to predict what effect a change in volatility will make on the detonation value of a fuel.

* * *

### New Uses

*Wax Tailings. Augustin.* (*Chem. Techn. Fabrick.* 25, 37-8 (1928). *Pine Inst. Amer. Abs. Vol.* 2, *No.* 5, 1928, *p.* 75). The properties of wax tailings (asphaltic in nature, coming over at the end in mineral oil distillation) are briefly discussed. This product in solution is useful as an impregnating agent for wood and similar substances. A good adhesive banding material for use against caterpillars, insects, etc., is composed of mineral oil (non-drying and non-hardening) 40, wax tailings, 35, rosin 20, and lime soap, 5 per cent. Mixed with hardened rosin, wax tailings give a binding material that is a powerful adhesive up to 35 degrees C. When treated with tannic acid to reduce its stickiness it may be incorporated with turpentine in black shoe polishes.

---

Graver Corporation, East Chicago, Indiana, has opened an office in Los Angeles at 808 Pacific National Bank Building. The office is in charge of Frank M. Beeson, who has been in charge of the Los Angeles branch of the Luitweiler Pumping Engine Company for several years. This company has been the Pacific Coast distributor of Graver products.

---

"Which Do You Prefer?" is the title of a new bulletin which compares the Turner Boiler Baffle Wall with the BECO Baffle Wall. Both are built by the Boiler Engineering Company, 931 Federal Trust Building, Newark, New Jersey. Copies of the bulletin will be mailed on request to the company.

---

Botfield Refractories Company, Philadelphia, has announced that effective on June 1 the company's products, Adamant fire brick cement, Adachrome and Adachrome fines and the Adamant gun for Toledo, Ohio, and vicinity will be handled by the Builders Industrial Supply Company, 4090 Detroit Street, Toledo.

Patented
R. S.
Alligator
Oil Thief

**New Improved**

# Alligator Oil Thief

**3-inch Quick Opening Trap or**
**2-inch Quick Opening Trap**
***(No Tools Required)***

**Can't Stick**
**No Clogging**
**Easily Adjusted**

SAMPLES accurately taken at any depth by use of GAGE POLE or CHAIN.

**12-inch OIL THIEF adjustable for bottom settlings samples up to 21 inches. Rugged construction.**

THE SERVICE ACCURACY R.S.C. TULSA

*Manufactured by*

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**The "V"-shaped flexible bar of the "V" Pilot is slotted to prevent leakage and retain lubrication. The metallic face offers less frictional resistance and yet maintains a tight seal without friction or scoring.**

## "Far Superior" *for Refinery Service*

**"ON compressors handling sour gas," writes a certain refinery, "we have been using "V" Pilot Packing, and find that it is far superior to any kind of packing previously used."**

**Time and again where packing jobs in refineries and gasoline plants have been entrusted to "V" Pilot, it has proven its ability to hold the pressure, prevent leakage and serve longer.**

**Not only on air, gas and ammonia compressors, but also on oil, gasoline, sludge acid pumps, hydraulic presses in wax plants, stop valves and valve stems, you can use "V" Pilot to advantage. Try "V" Pilot also on steam glands and see how it stands up under your own conditions. If your jobber does not stock "V" Pilot, we shall be glad to quote you, or furnish data on specific applications. Write us today.**

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Our friends told us, when we decided to convert a successful general oil-industry publication, into **three** specialized oil journals that "we were taking a chance." But we knew we weren't. On every hand we had evidence of the trend toward specialization.

In architecture there were men who specialized in getting business, others who specialized in design, and others who specialized in the writing of specifications. In advertising there were copy specialists, layout specialists, media specialists. No longer was a man just "an engineer"—he was a **mining** engineer, a **power plant** engineer or some other specialized kind of engineer.

Even more important than these things was our knowledge of the oil industry. We knew that production, refining and marketing were three divisions as separate from each other as tanning of hides is from the sellling of shoes. We knew, moreover, that each of these branches was in itself an industry of immense proportions requiring the most specialized type of knowledge. We knew that the man identified with oil production was forced to extend himself to keep abreast of producing problems—without worrying about the refiner's job or the oil marketing situation. We knew that the man who specified bits does not specify cracking stills or filling station pumps.

These were the facts that gave birth, years ago, to THE OIL WEEKLY (for producers), THE REFINER, and THE PETROLEUM MARKETER. They express the characteristics that distinguish these papers from the general run of oil-industry publication. Each of the Gulf Publishing papers contains the basic news of the industry that the oil men want to know. Beyond that they have nothing in common. No reader, as one engineer puts it, "is forced to go through a lot of matter in which he is not interested in order to get to the information in which he is interested." No manufacturer is asked to advertise to marketers a product that appeals only to producers. There is 100% reader interest for the reader—100% value for the advertiser.

Has the specialized policy proved a sound one? Judge for yourself—THE OIL WEEKLY has the greatest number of producer readers ever presented on a single subscription list. THE REFINER has more refiner readers than any other publication in America. All three publications are enjoying a great and constantly increasing advertising patronage.

The story of specialization is an interesting one and an important one if your product is or could be sold to the oil industry. May we send you full details?

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*Mention Where You Saw the Advertisement*

# NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS

*G-R Bentube Section*

## Griscom-Russell Products

**GRISCOM-RUSSELL COMPANY**

Griscom-Russell Company, 285 Madison Avenue, New York, announces two new devices of interest to refiners, a heat exchanger called the G-R Tubeflo Section and a cooler and condenser called the G-R Bentube Section.

### G-R Bentube Section

The patented G-R Bentube Section is a cooler and condenser which is said to automatically crack off scale deposited on the cooling surface by the cooling water.

The apparatus consists of a series of Admiralty metal tubes set with an initial curvature into cast iron headers at each end. The liquid or gas to be cooled or the vapor to be condensed passes through the tubes, and the cooling effect is obtained either by showering water down over the tubes from distributing spray nozzles or a cooling tower set above them or by submerging the entire unit in a tank of water.

As the cooling water is heated or evaporated on contact with the hot tubes, it leaves behind deposits of scale. These deposits are taken care of in the G-R Bentube Section as follows: When the hot liquid, gas or vapor passes through the tubes, the resulting expansion greatly accentuates the initial bowing of the tubes. If the flow of the hot fluid is interrupted, the tubes again contract to their initial curvature and this readily controlled change in flexure is made use of to crack off scale accumulations.

In service, changes in curvature of the tubes may be accomplished either by stopping the flow of cooling water while the hot fluid continues to pass through the tubes or by stopping the flow of the hot fluid while the cooling effect is continued. In the former case, scale is cracked off by the increased distortion of the tubes caused by the additional heating effect, and in the latter case, scale is cracked off by the contraction of the tubes as they cool.

The G-R Bentube Section is recommended in applications where the cooling water supply is of poor quality, and may be used for cooling oil, gas, jacket water and industrial liquors or for condensing steam or vapors of various oils and chemicals. Any available raw cooling water may be used.

By installing additional sections, these units may be arranged in parallel to permit increase in capacity or stacked in series to give greater cooling effect.

### G-R Tubeflo Section

The main portion of the section consists of a number of body pieces which are bolted together to make up the required length for a desired cooling effect. At one end of the section is bolted a stationary head, which contains the inlet and outlet connections, together with the necessary partitions for directing the flow of the mediums through the four chambers of the body pieces. At the opposite end of the section, a floating bonnet forms a cross-over connection between the passages. The stationary head is also provided with a removable cover which permits easy inspection of the chambers and accessibility for cleaning.

*G-R Tubeflo Section*

Various parts of the section are standard and interchangeable. Sections are readily made longer or shorter by changing the number of body pieces; they can be installed in stacks one over another, and any number of stacks can be used in parallel, depending upon the duty which they are to handle. When arranged in stacks, the stationary heads of the sections are bolted together, and the body pieces of each section are held in proper position by lugs which permit movement for expansion and contraction.

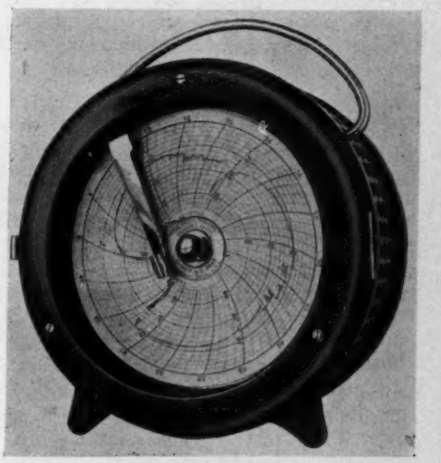
The smooth cored passages permit the use of high velocities of the hot and cold fluids passing through the section, with correspondingly high heat transfer rates, but low resistance to flow.

## Bristol Thermometer

**THE BRISTOL COMPANY**

The Bristol Company, Waterbury, Connecticut, has perfected and is now marketing a new Model 144 recording thermometer. This device is a miniature instrument, using a chart but four inches in diameter. The charts are designed with particular attention to the type of service required and offer clear readings over appropriate ranges.

The new model is easily portable. The measuring element consists of a bi-metallic helix, which is positive in operation and said to be extremely sensitive to temperature changes. The pen arm is attached to the measuring element and records directly on the chart. A special frictionless form of inverted pen arm with fountain pen is standard equipment, assuring, it is claimed, a sufficient supply of ink and a uniform record line over the complete chart revolution of 72 hours. A special clock is used to revolve the chart. The clock is built with extra precautions against rust and the possible action of moisture.



*Bristol Thermometer*

More information is obtainable through the company, by request.

## New Safety Gas Mask

### MINE SAFETY APPLIANCE COMPANY

A gas mask for use in gauging tanks is announced by the Mine Safety Appliance Company, Braddock Avenue and Thomas Boulevard, Pittsburgh, Pennsylvania. It is claimed that this mask affords complete protection against hydrogen sulphide gas and other fumes from sour crudes and distillates.

The mask is a Canister type with single inhalation tube. The face piece fastens to two flexible inhalation tubes, one over each shoulder, joining a substantial Y connection in the back between the shoulders. It is claimed that this arrangement makes it practically impossible to twist the tubes and assures the wearer an uninterrupted supply of air even though one tube is temporarily closed. The mask is especially adapted to workers needing freedom from apparatus on the chest.

The Kops type face piece, standard for the U. S. Army, is used on all tank gaugers' masks. By means of adjustable head bands, the face piece is arranged to fit any face.

A deflector tube in the face conducts the dry incoming air over the non-shattering safety lenses and prevents fogging of the lenses.

The exhalation valve closes instantly on exhalation, it is said.

Further details can be secured by writing the company.

---

Wilson-Snyder, Pittsburgh, Pennsylvania, has issued a new leaflet on high pressure hot oil pumps. Copies will be mailed on request for Bulletin W-17N.

*Safety Gas Mask as worn and used*

## Temperature Controller

### AMERICAN SCHAEFFER & BUDENBERG CORPORATION

A new type of temperature controller is announced by American Schaeffer & Budenberg Corporation, 338 Berry Street, Brooklyn, N. Y.

This new regulator has been designed, say the makers, to meet the growign demand for a self-contained automatic controller of simplicity and high sensitiveness. By combining a flexible bellows of new design with an operating spring of large diameter and great length, a mechanism has been secured which is said to hold temperatures constant within very close limits. With favorable conditions, regulation can be secured within one degree Fahrenheit consistently without need of manual attention.

This instrument is made in a number of standard temperature ranges and can be set as desired. The setting point may be adjusted by turning a nut, which varies the tension of the valve spring and thus determines the pressure required to expand the bellows. A scale enables a given adjustment to be repeated accurately after it has been changed.

Of particular importance is the safety device to guard against damage to the bellows from overpressure caused by accidental overheating. This device is in the form of a spring, which is placed between the upper and lower parts of the valve stem. If the pressure in the bellows increases after it has completed its stroke and the valve is seated, this spring will be compressed, thus allowing further expansion. The greatest pressure which can be generated in the system will not damage it.

The precision controller is particularly suited for hot water service tanks, water heaters, retorts, cookers and kettles or wherever a simple controller is required for very close regulation.

More information may be secured from the company, by request.

## Reseating Machine

### THE LEAVITT MACHINE COMPANY

The Leavitt Machine Company, Orange, Massachusetts, announces the Dexter Tank Car Outlet Valve Reseating Machine, which enables tank car users to reseat the outlet valves without removing them from the tanks.

The machine consists of a universal chuck for centering and holding to the valve. The chuck back is used for a guide to the cutter, and is equipped with both feed nut and lock nut, which give a positive feeding arrangement.

Two sizes of the machine are available, one for six and one for four-inch valves.

The work is done from the inside of the tank. One man can set up and operate the machine.

Further information is available from the company, by request.

*Valve Reseating Machine*

# STRUTHERS-WELLS HEAT EXCHANGERS

ECONOMY in operation is best obtained with reliable equipment designed for a specific service.

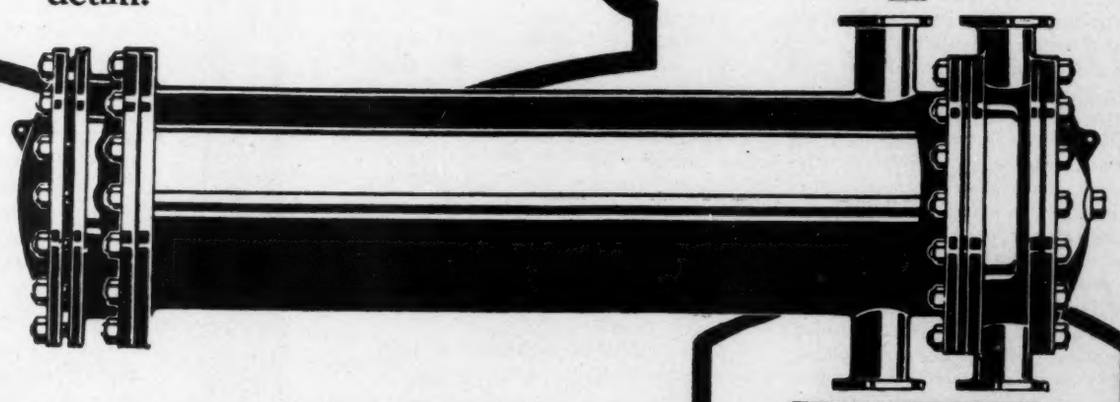
Struthers-Wells Heat Exchangers combine—

*Simplicity*
*Ruggedness*
*Flexibility*
*High Efficiency*
*Low Maintenance Cost*
*Complete Accessibility*

Our Bulletin 10 describes these features in detail.

**Made in sizes from 75 sq. ft. to 5000 sq. ft.**

**TYPE T**



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FRACTIONING TOWERS
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STRUTHERS-WELLS COMPANY

## STRUTHERS-WELLS COMPANY

**1020 Pennsylvania Ave. -:- Warren, Pennsylvania**

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## Ohiolock Return Bend

### THE OHIO STEEL FOUNDRY

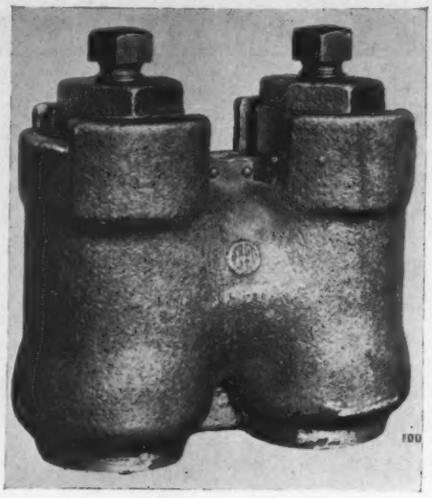
The Ohio Steel Foundry Company, Springfield, Ohio, announces a new return bend, which is called the Ohiolock Frictionless.

The new fitting is manufactured of electric cast steel. A one-piece plug is held in position by a set lock of superior strength. This set lock is turned clockwise in the return bend casting to a positive stop, the stopping and holding medium being held tightly in place on the end of the bend. There is a latch assembly integral with the return bend casting which engages with the plug or valve and holds it in its positive place. The latch assembly is so arranged that when disengaged, the plug can be rotated with a valve seating tool.

With this type of bend one tube may be replaced without moving the adjacent tube.

It is claimed that maximum strength is secured in this design of return bend.

More information may be secured from the company, by request.



*Ohio Return Bend*

## Portable Arc Welder

### PONTIAC TRACTOR COMPANY

A new mounting of the Standard Lincoln Electric Stable Arc Welders has been announced by the Pontiac Tractor Company, Pontiac, Michigan.

The welder unit with stabilizer and panel are mounted on a frame, which attaches to either the McCormick-Deering 10-20 or Fordson tractors.

This mounting of the Pontiac Lincoln Arc Welder gives a four-wheel, rubber-tired, self-propelled unit, capable of hauling heavy loads behind itself. This unit is also mounted on crawlers for soft ground work.

Power is taken from the tractor to drive the welder, through the power takeoff pulley, which has a clutch, allowing it to be thrown out or into gear at will. The ahead drive of the belt brings the belt tightener into the correct relation with the belt.

More information will be supplied by the company, on request.

## Concrete "Form-Hold"

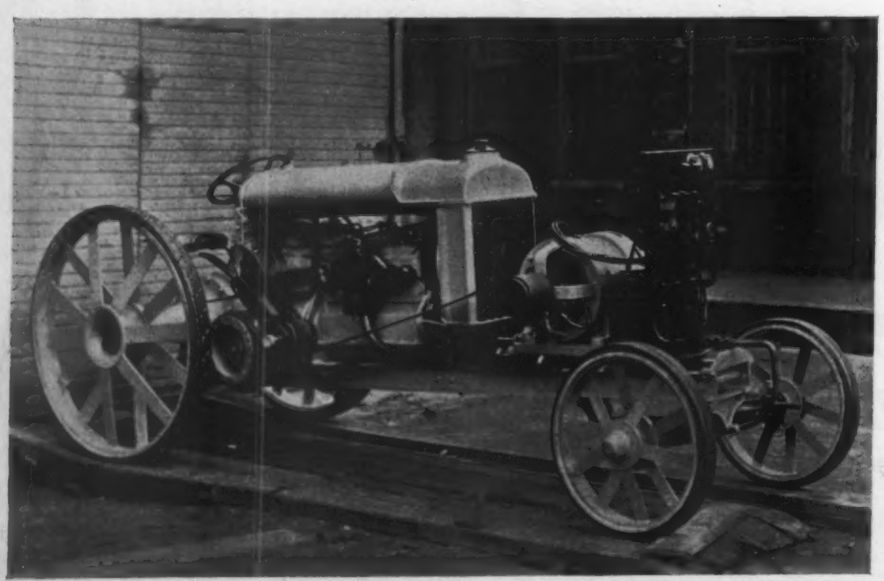
### CONCRETE "FORM-HOLD" CORPORATION

Concrete "Form-Hold" Corporation, Culver City, California, announces the "Form-Hold" for building concrete forms.

The device is of one-piece, reversible sheet-metal construction, designed with three tension members that lie flat between the edges of the form boards, with staggered ridges, properly notched to receive the form boards and reinforcing.

These notches are designed for a three-fold purpose: The outer notches tie and space the form board; the center notches hold the reinforcing steel in place; and the center notches act as vents, thereby preventing the formation of voids in the wall.

More detailed information may be had by writing the company.



*New Electric Arc Welder Mounting*

## Bulletin Announcements

Celite Products Company, 1320 S. Hope Street, Los Angeles, announces publication of two new bulletins: No. 101 called, "Sil-O-Cel Insulating Materials and Allied Products," and No. 141, "The Insulation of Breechings and Stacks."

Copies of both may be secured from the manufacturer, by request.

---

Busch-Sulzer Brothers Diesel Engine Company, St. Louis, Missouri, has published a new catalog describing the Type E Busch-Sulzer Diesel engine. The engine is adaptable for refinery use as an emergency unit for stand-by service, or for other installations where space and weight limitations are guiding factors.

Copies of the bulletin may be secured from the company, by request.

## Safety Flashlight

### NATIONAL CARBON COMPANY

The National Carbon Company, New York, has perfected and put on the market a new flashlight known as Eveready Safety Flashlight No. 2695.

*Safety Flash Light*

This flashlight has a special spring mounted lamp and an extra heavy projecting lens ring. If its bulb is shattered the sensitive spring is released, the glass lamp is disconnected and hurled forward and the current is cut off automatically. This eliminates the possibility of the lamp filament firing any surrounding gaseous mixture which may penetrate the case.

The Bureau of Mines has approved the flashlight for safety in methane and air mixtures as has the Underwriters' Laboratories, the latter body also approving its use around gasoline vapor mixtures.

More information may be had by writing the company.

---

The oil refinery engineering and construction business as conducted in the past by the Widdell Engineering Company and Arthur G. McKee and Company, Associates, will in the future be carried on under the name of the latter company exclusively. Although the corporate name of the Widdell Engineering Company will be abandoned, the personnel will remain intact as a part of the McKee Company organization. H. E. Widdell becomes vice-president and a director of Arthur G. McKee and Company in charge of oil refinery sales, design and construction.